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THE HISTORIC FLUCTUATIONS OF THE CASPIAN SEA.*

BY

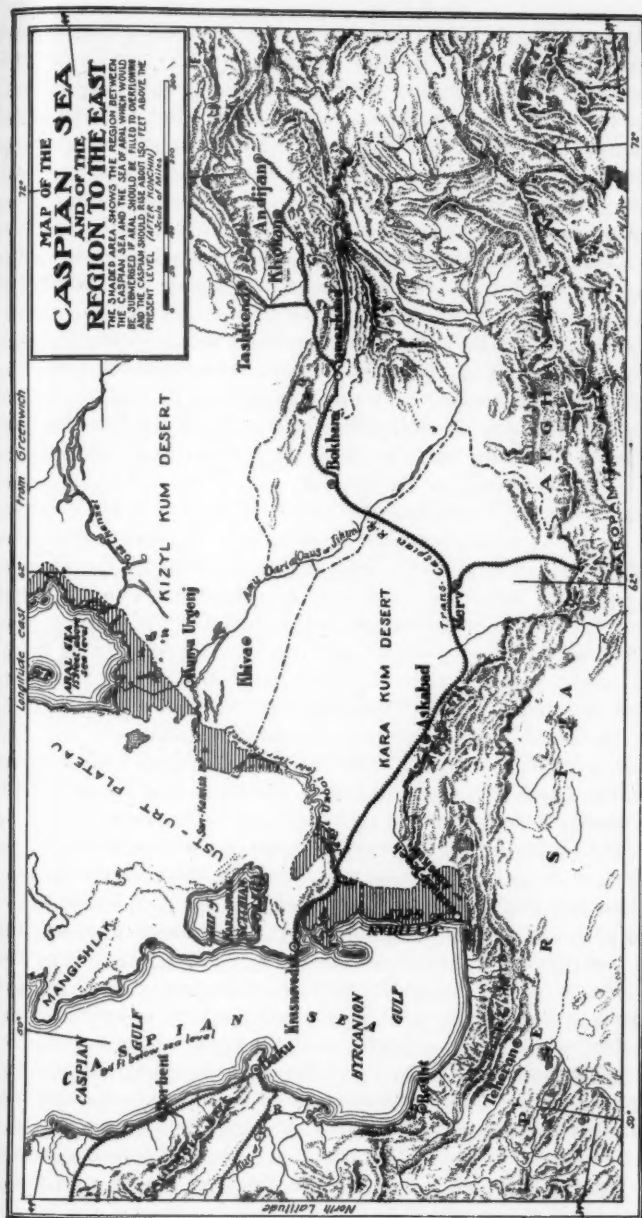
ELLSWORTH HUNTINGTON.

The fluctuations of the Caspian Sea and the nature of its connection or lack of connection with the ocean have been matters of discussion from the time of Herodotus until to-day. The possible overflow of the Sea of Aral to the Caspian and the alleged diversion of the Oxus River from the smaller sea to the larger have introduced complications which have rendered the problem very difficult of solution. Humboldt has devoted almost two hundred pages of his great work on Central Asia to the subject; Rawlinson has investigated it carefully; Brückner has made an exhaustive study of the fluctuations of the sea, especially during the last two centuries; and many other writers have contributed more or less to a discussion which began two thousand years ago, and in which no agreement has as yet been reached. Some writers have believed that a deflection of the Oxus River from one sea to the other is enough to account for all the recorded changes; others have appealed to movements of the earth's crust in explanation of the complex phenomena; and a few have assumed a progressive change of climate. None of these explanations has proved tenable, for the facts seem to show not only that there have been long epochs of high water alternating with epochs of low water, but that these have occurred without reference to changes in the Oxus River or to movements of the earth's crust. If, however, it be assumed that during historic times the climate of the Aralo-Caspian basin has been subject to *fluctuations* having a period of hundreds of years and decreasing in amplitude from the past to the present, all the phenomena appear to find a satisfactory explanation.

* This article is a modified chapter of the writer's book, entitled "The Pulse of Asia," soon to be published.

Among the ancients some considered the Caspian Sea a part of the great stream of ocean surrounding the habitable earth; others supposed it to be one of four symmetrical gulfs which were thought to penetrate from the northern and southern oceans into the dry land; while still others, who knew that it was an enclosed basin, inferred that it must have an underground outlet to the Black Sea, which, as a matter of fact, lies 85 feet *above* it. Previous to the days of Herodotus the Caspian Sea is mentioned only vaguely. Two ancient records, one Greek and one Egyptian, have been supposed to refer to it, and possibly to the Sea of Aral; and the traditions of the Argonauts have been thought to show that water communication existed between the Black Sea and the Caspian, but there is no certainty in either case.

Herodotus, about B.C. 458, visited Olbia on the Black Sea at the mouth of the Dnieper River. He there obtained from the merchants such accurate information that he was able to state definitely that the Caspian Sea was completely isolated and had no outlet. He makes the north and south axis six times as long as that from east to west, although now it is only between three and four times as long. Of course we have no certainty that Herodotus had anything more than the unreliable accounts of travelling merchants. Nevertheless, it is interesting to see how well his information agrees with the conclusion to which we are led by other evidence. The width of the Caspian Sea between the Caucasus Mountains and the Ust-Urt plateau, the part with which the Olbians would be most familiar, is about two hundred miles, and would not be greatly increased even though the level of the water rose several hundred feet. If the length of the sea were six times two hundred miles, water would extend from about its present limit at the foot of the Elburz Mountains on the south to north of Samara in the plains of Russia, and this is just what would happen if the level of the Caspian were about two hundred feet higher than it now is. Herodotus says, also, that the Jaxartes or Syr River, after throwing off many small arms to feed a lagoon, which Rawlinson surmises to be the Sea of Aral, entered the Caspian in a single stream. Possibly the Jaxartes may have followed an old channel which, as the map shows, joins the Oxus near that river's mouth; and the united streams may have flowed by another old channel, the Uz-boi, from north of Khiva to the Caspian. The data given by Herodotus as to the Jaxartes do not agree with those of his successors, which may mean either that conditions were subject to change or that the Father of History, at a distance

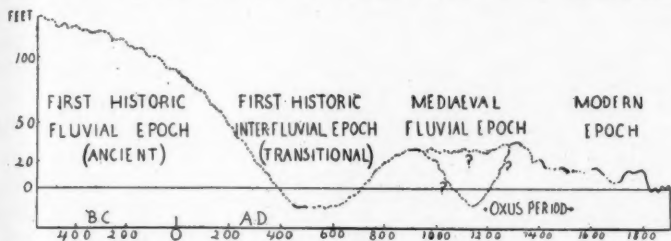


of fifteen hundred miles from the Jaxartes, could not obtain exact information.

Aristotle, B.C. 348, the next authority on the Caspian Sea, follows Herodotus strictly. A few decades later Alexander and his generals commissioned some of their subordinates to study the geography of the new regions to which the Greeks had lately penetrated. The geographers did not visit the northern side of the Caspian, but confined themselves to the southern shore south of the Caucasus Mountains on the west and of what is now the Sea of Aral on the east. Aristobulus, the geographer of Alexander, is quoted by Strabo as saying that in the fourth century before Christ the traffic from India came down the Oxus River to the Caspian, into which the river apparently flowed; crossed the sea; went up the Cyrus River to its head; down the Phasis to the Black Sea, and so to Europe. A little later, about 300 B.C., Patroclus, the admiral of Seleucus, made a survey of the southern coast of the Caspian. According to his account, the Oxus and the Jaxartes rivers both entered that sea, the mouth of the one being two hundred and forty miles from that of the other. To-day both streams enter the Sea of Aral, their mouths being about as far apart as they were in the days of Patroclus. Under the present conditions of water-supply it might be possible for the Oxus to flow to the Caspian Sea without entering Aral; and even the Jaxartes might possibly pass the Aral depression without entering it; but if it did the Ust-Urt plateau to the west would force the river so far to the south that it would inevitably join the Oxus two or three hundred miles from the present shore of the Caspian. Therefore, under present conditions, the Oxus and Jaxartes could not possibly enter the Caspian Sea by separate mouths. If, however, the Caspian were to expand so as to coalesce with the Sea of Aral, or to be separated from it only by a short sound or river, the two seas might be regarded as one, and the conditions would agree with the description of Patroclus. The absence of any distinct mention of the Sea of Aral by either Greeks, Chinese, or Persians down to the time of Menander of Constantinople, A.D. 590, suggests either that no such lake existed, which is extremely improbable, or that it was regarded as a part of the expanded Caspian.

The reports of Aristobulus and Patroclus have been discredited, because these men, or some others of Alexander's followers, confused the Paropamisus Mountains of Afghanistan with the Caucasus range; and, finding the name of Don or Tanis attached to the Jaxartes, supposed it to be the Don or Danube of Europe.

Opinion is divided as to how fundamental their geographical errors may have been. They, perhaps, were wrong in saying that the Caspian Sea was a gulf of the northern ocean symmetrical with the Persian Gulf on the south, and, like it, separated from the main ocean by a narrow strait. Their mistake, however, if mistake it was, is not so great as it appears at first sight. Humboldt, Wood, and others have favoured the hypothesis that in ancient, perhaps prehistoric times, the Caspian and Aral seas formed a single body of water, which discharged to the north. The supposed outlet was from the Aral Gulf of the enlarged sea along what has now become a line of lakes leading toward the Irtysh River. The hypothesis lacks confirmation, but the physical features which have given rise to it may have given rise to the Alexandrine idea of a northern passage leading to the Arctic Ocean. It is not likely, however, that such an idea would prevail unless the Caspian had stood at such a level that it almost, or quite, coalesced with the Sea of Aral.



APPROXIMATE CHANGES IN THE LEVEL OF THE CASPIAN SEA.
ZERO=BRÜCKNER'S DATUM LEVEL, 85 ± FEET BELOW THE BLACK SEA.

Another explanation of the Alexandrine error is possible. When the Greeks inquired as to the northern shores of the Caspian Sea, they would hear that the water stretched away indefinitely to the north, where a narrow channel, the almost motionless stream of the mighty Volga, up which ships can sail for nearly two thousand miles, led far toward the Arctic regions. Under the prevailing ideas as to the symmetrical distribution of sea and land, the geographers would naturally come to the conclusion that the Caspian Sea was a gulf of the ocean corresponding to the Persian Gulf on the opposite side. Such an error would be even more likely to spring up if the Caspian extended far to the north over the plains of Russia, as the account of Herodotus suggests, and as it must have done if it were so expanded eastward that the Oxus and Jaxartes rivers both entered it.

The Alexandrine idea of a northern outlet of the Caspian Sea

remained almost unchallenged for nearly five centuries, until the days of Ptolemy. Diodorus of Sicily, B. C. 60, is the only author, so far as we know, who speaks of the complete isolation of the sea during this period; and he does so only incidentally. All the others appear to have accepted the Alexandrine accounts as superseding those of Herodotus and Aristotle. As no one visited the northern coasts of the Caspian, there was no means of ascertaining the error. Nevertheless, the later geographers add materially to our knowledge of the shape and size of the sea. Pomponius Mela, A. D. 40, says that it has three main parts—the Caspian Gulf to the north, the Hyrcanian to the south, and the Scythian to the east. A glance at the map shows that the Caspian and Hyrcanian gulfs are to-day easily recognizable. There is also a far smaller gulf on the east, that of Kara-Bugaz, which may be the Scythian Gulf. If the water stood fifty or more feet higher the Kara-Bugaz would not change much, but a larger and much more noticeable gulf would be formed to the south of Kara-Bugaz, and would be a notable feature. The individuality of the other gulfs would also be increased. The importance of the Scythian Gulf is confirmed by Pliny, who mentions it in A. D. 69. A little earlier, in A. D. 20, Strabo has recorded some data as to the distance from the mouth of the Phasis River in the Black Sea to that of the Cyrus in the Caspian, as to the breadth of the sandy plain on the west coast of the Caspian, and as to other features. His figures seem to show that at that time the sea stood at a higher level than now. From them Khanikof has estimated that in the first century of the Christian era the level of the Caspian Sea was eighty-five feet higher than now. If this is true, the southern of the two eastern gulfs, which was probably the Scythian Gulf, must have extended far toward the Sea of Aral, with which it may have coalesced at an earlier, higher stage.

The last ancient author who makes any important contribution to our knowledge of the Caspian Sea is Ptolemy, A. D. 160, one of the most accurate among Greek and Roman geographers. He abandoned the Alexandrine idea of a northern outlet, and asserted that the sea was completely enclosed. His map makes it over twice as long from east to west as from north to south. This is due—in part, at least—to the fact that all his east and west distances are exaggerated, especially in remote regions where accurate data were hard to obtain. It may be, however, that when he became convinced that the sea was not connected with the northern ocean, he supposed the so-called Caspian Gulf to be also a mistake, and

accordingly made the sea consist of only the Hyrcanian and Scythian gulfs.

Most of the information of the preceding paragraphs has been gleaned from Humboldt's great book, "*Asie Centrale*." In dealing with the records of ancient authors two mental attitudes are possible. One, exemplified by Murchison in his paper on the Caspian, assumes that the ancients were essentially wrong, and that their geographical accounts are worth studying only as literature. The other, exemplified by Humboldt, assumes that the ancients were much like the moderns, generally right as to facts of personal observation, but often wrong in their inferences, and not always careful to distinguish between the two, or between information acquired at first hand and that quoted from others. If we adopt the second attitude, it is impossible to reconcile the ancient accounts with the facts, unless we accept the hypothesis that in the days of Herodotus and Alexander, over twenty-two hundred years ago, the Caspian Sea stood from a hundred and fifty to two hundred and fifty feet higher than now, and almost coalesced with the Sea of Aral. Three or four centuries later, at the beginning of the Christian era, the water had apparently fallen to a level a hundred feet or less above that of to-day, the sea being still much larger than at present.

It is not possible as yet to connect any physiographic evidence directly with the high stand of the Caspian Sea which we have inferred from the data of history. Nevertheless, as I saw in 1903 when travelling with Professor W. M. Davis, the sea is bordered by abandoned strands lying at various heights up to six hundred feet above the present water-level. The state of preservation of the lower strands shows that they are of very recent origin, though no one has yet succeeded in correlating them with any events of human history. Their weak development indicates that, as a rule, the sea did not stand at any one level for a long time. Other features, as Professor Davis has pointed out, suggest that the strands were formed by a lake which alternately rose and fell, as would happen during alternate fluvial and inter-fluvial epochs. At Jebel, on the Central Asiatic railroad, a hundred miles east of the terminus at Krasnovodsk on the Caspian Sea, we saw two particularly interesting strands at an elevation of two hundred and fifty and one hundred and fifty feet above the Caspian. The lower occupies the position where, according to the conclusion reached above, the shores of the Scythian Gulf stood in the days of Herodotus and his successors.

If we grant that such an expansion of the Caspian Sea is a fact

of history, the question arises whether it can be explained without postulating a change of climate. An increase in the amount of water used for irrigation during more recent times cannot be appealed to, for it is generally admitted that the population, and hence the consumption of water in the Aralo-Caspian basin, was greater in ancient than in modern times. Warping of the earth's crust will not explain the matter; for granting that the position of the sea may have been altered by this means, the water-spread, or surface exposed to evaporation, would remain practically constant so long as the climate remained constant. The water-spread of ancient times, however, appears to have been very great, possibly almost double that of to-day. Changes in the course of rivers are an equally inadequate explanation for the same reason. The Oxus and the Jaxartes are the only rivers which have been seriously suggested as possible contributors to the expansion of the Caspian Sea. Between them they furnish most of the water which balances the evaporation from the 26,000 square miles of the water-spread of the Sea of Aral. Even if they could avoid depletion by underground drainage into the basin of Aral, two hundred and twenty feet below the present level of the lake, they would still have to meet the losses incident to a course of nearly four hundred miles through the sandy desert without re-enforcement from tributaries before reaching the Caspian. On the way they would have to maintain a lake in the depression of Sari-Kamish (Yellow-Reeds), which lies in the course of the old Uz-boi channel, for its bottom is fifty feet below the level of the Caspian Sea. Having met all the losses, the united streams would by no means be able to add 26,000 square miles to the water-spread of the Caspian. The ancient expansion, however, amounted to far more than this. Apparently we must either disregard the ancient authorities entirely, or else admit a change of climate. The climatic hypothesis is supported not only by the agreement of the phenomena of the Caspian with those of distant regions, but by the evidence of old oases, such as those of Merv and Bal Kuwi, near Askhabad, where the ancient water supply seems to have been much larger than that of to-day. These two places appear to be typical of many in the Aralo-Caspian basin, where streams have diminished in size during historic times.

Returning once more to our investigation of the varying level of the Caspian Sea, we find a surprising change between the conditions in the first century of the Christian era and those of four or five centuries later. About the beginning of our era the trade route from Europe to India altered its course, as did the one from

China to the West. It ceased to go up the Oxus River, perhaps because the Caspian had so far contracted that the river no longer reached that sea, but fell into the now isolated Sea of Aral. The new route crossed from the mouth of the Cyrus River to the southwest corner of the Caspian, where in time there grew up a flourishing seaport, called Sokona, or Aboskun (Water of Oskun, or Sokona), at the mouth of the Gurgun River. The site of Aboskun is marked by the ruins of Gumush Tepeh, or Silver Hill, from which the so-called "Red Wall," a great bulwark against the Huns, stretches eastward to the mountains in a line of mounds a hundred and fifty miles long. The Caspian Sea, to quote Rawlinson, "must have been at a very low level when Aboskun and the great wall were first commenced, if it be true, as the Russian Surveys report, that remains of masonry along the line of the wall can be traced below water eighteen miles from the shore." O'Donovan and Eichwald also speak of the wall and of a caravan-serai of Aboskun which now lies under water. The most reliable and ancient Persian tradition, according to Rawlinson, relates that the wall was built by the Sassanian king, Firuz, against Kiyataleh, between A. D. 459 and 484.

At Derbent, on the western shore of the Caspian Sea, four hundred and fifty miles from Aboskun, there is a great wall of the same sort, supposed to have been built in the fifth or sixth century of our era. Its base is said to be slightly under water. In the Bay of Resht, according to Brückner, there are houses of unknown date standing in the sea, although they certainly were built on dry land; and Sokolof relates a Persian account of the ruins of a submerged city near the mouth of the Kur, or Cyrus River. Finally, at Baku we saw the towers of a well-preserved caravan-serai projecting above the water some distance from the shore. Their base lies fifteen feet below the level which Brückner has taken as zero in his investigations of the fluctuations of the sea. Lenz believes that the caravan-serai dates from before the founding of Baku in its modern site in the fifth or sixth century; but Brückner, on the basis of architectural resemblances, considers it of Arab origin, dating from the twelfth century. However this may be, the walls of Aboskun and Derbent are sufficient to prove that about 500 A.D. the level of the Caspian Sea was as low or lower than it is to day. The climate must then have been at least as dry as it is now.

During the succeeding Middle Ages there is unmistakable evidence that the level of the Caspian Sea again rose, though not to such a great extent as formerly. So far as the water-spread of the

mediaeval sea is concerned, it is probably possible that the expansion of the sea may have been due to the deflection of the Oxus and Jaxartes rivers from the Sea of Aral to the Caspian. There is evidence that such deflection took place, or, at least, that part of the water of the rivers was so deflected. Hence it is necessary to proceed with the greatest caution, in order to ascertain whether the expansion of the lake occurred independently of the changes of the rivers. The chief evidence, one way or the other, is found in the works of various Arab and Persian authors quoted by Humboldt and Rawlinson. I shall assume that these Oriental authors are correct, unless there is clear reason for doubting their information.

During the Dark Ages, in the seven and a half centuries between the time of Ptolemy and of Istakhri, A.D. 920, war and confusion prevailed in the Aralo-Caspian region. The only addition to our knowledge of the two salt lakes is Menander's mention of the existence of the Sea of Aral as a great lagoon. With Istakhri, however, we enter upon a new era, a time when the Arabs and Persians rose to a high state of civilization and produced a literature of great excellence. They were especially proficient in geography and related sciences, and have left several works of high accuracy. One of the best of these is that of Istakhri. He corrected the Alexandrine idea of a northern outlet of the Caspian Sea, which, in spite of Ptolemy, was still prevalent. In a journey around the sea he came to Derbent, where he records that the old wall projected into the sea so far that six of its towers stood in the water. Brückner considers that there is good evidence that none of the towers have disappeared, and, therefore, concludes that about 920 A.D., at the time of Istakhri's visit, the Caspian stood twenty-nine feet higher than the modern mean level, or zero. Now, at that time the Oxus quite surely did not enter the Caspian. Istakhri's map shows it as entering the Sea of Aral, whose circumference is said to be one hundred parasangs (nearly four hundred miles). Moreover, Istakhri says distinctly, "Aral receives the Oxus, Jaxartes, and a number of other rivers. Nevertheless, one perceives no increase in its waters; and so one supposes a subterranean communication with the Caspian Sea." If he supposes *subterranean* connection, there manifestly was no visible connection. Elsewhere he speaks of the mouth of the Oxus as being ten days' journey, about two hundred and fifty miles, from that of the Jaxartes; but there is no hint of any connection with the Caspian. In describing the lake, he says: "On the shore itself of Aral there is a mountain called Sheghagher, on which snow remains from winter almost to the end of summer."

So far as I know, there is now no place near the Sea of Aral where snow stays so long.

The next important author, Edrisi, A.D. 1154, speaks of Aral as "a well-known lake," and confirms most of what Istakhri says, including the snow. He gives the distance, however, between the mouths of the Oxus and Jaxartes, in Lake Aral, as only ten miles. This, apparently, means that the Jaxartes had then changed its course to the old channel, already referred to in connection with Herodotus, a course which it appears to have followed intermittently. It flowed there as late as 1816. Of the Caspian Sea, Edrisi says that "it is elongated from north to south *less* than from east to west. [The italics are mine.] The two axes have the ratio of four to three." His map, however, shows it otherwise. It seems as if we had here a revival of the Scythian Gulf, either because Edrisi had read Ptolemy, or, more probably, because the rising water of the Caspian had once more broadened the southern end of the sea.

According to Rawlinson, "The Arab geographer Yacut [about A.D. 1225] furnishes the earliest record of the Oxus having found its way into the Caspian, after it had been turned into its old bed by the Moghuls at the siege of Urgenj [ancient Khiva] in 1221." Rawlinson, it should be said, believed that in ancient Greek times the Oxus flowed to the Caspian. Hence his reference to the "old bed" into which the Mongols diverted the river. Abul-feda, seventy or eighty years after Yacut, describes the Oxus and Aral in essentially the same way as Istakhri and Edrisi, with no reference to any connection with the Caspian. Possibly the overflow of the Oxus to the Caspian lasted only a few years. A later writer, however, Hamdulla, the Persian, in 1325 A.D. tells us that Aboskun was then under water because the Oxus had been diverted from its old course about the time of the Mongols. He probably refers to the siege of Urgenj, and assumes that the water had remained high ever since, which may or may not have been true.

A few years before the date when Hamdulla wrote his account there had been another sudden rise of the Caspian Sea. This may have been due to a temporary diversion of part of the Oxus. Brückner tells us that, according to a story related by Marino Sanuto, the underground outlet by which the natives supposed the Caspian Sea to drain to the ocean was closed by an earthquake, whereupon the sea rose rapidly at the rate of about thirty-two inches a year, and some towns were submerged. Sheikh Sefi-Eddin says in reference to this that the water reached a certain

holy grave which lies thirty-seven feet above the present datum-level, and then, in the winter of 1306-7 began to fall. Now this date, be it noted, is within a year of the time when the Dragon Town on the shore of Lop-Nor was overwhelmed by the rising of that lake.* It is possible that an earthquake may have had something to do with the sudden rise of the Caspian, not by closing an outlet, but by diverting the Oxus. In view, however, of the similar rise of the lake of Lop-Nor over two thousand miles away to the east, it is more probable that at about this time there was a period of unusual rainfall, which caused the rivers and lakes to rise until the water of the Tarim River overwhelmed the Dragon Town, and that of the Oxus River broke from its old channel and flowed to the Caspian, causing a sudden rise of that sea. It was no such accident, however, which caused the original submersion of the ruins of Aboskun, as Hamdulla implies, for they were certainly under water at the time of Istakhri, four centuries earlier, when the Oxus did not flow to the Caspian.

Apparently, from 1221 A.D. onward for some centuries the Oxus bifurcated at certain times, one stream flowing to the Sea of Aral and one to the Caspian. Hamdulla, who has just been quoted, distinctly mentions such a bifurcation. He adds that the Sea of Aral had a compass of one hundred parasangs, from which it appears that the diversion of part of the Oxus had not materially diminished the lake. A century later a Persian writer, Sultan Shah Rukh, in whom Rawlinson puts much confidence, tells us that "in all ancient books the Lake of Kharezm [Aral] is described as the receptacle of the waters of the Oxus, but at the present date, which is A.H. 820 [A.D. 1417], the lake no longer exists, the Jyhun [Oxus] having made a way for itself to the Caspian, into which it disembogues at a place called Karlawn, or Ak-richeh." Elsewhere Shah Rukh repeats this assertion. He further says that, "The River of Khojend [the Jaxartes] in the lower part of its course, after passing into the desert of Kharezm, joins the Jyhun or Oxus, and thus ultimately reaches the Caspian." Rawlinson takes this to mean that the Jaxartes followed the old channel already referred to, branching southwest below Otrar, near Tumen, and joining the Oxus below Khiva, and that the united streams flowed to the Caspian through the Uz-boi, or old channel of the Oxus at the foot of the Ust-Urt plateau. If this is so the Caspian ought to have stood at a comparatively high level, as apparently it did, to judge from the following quotation from

* See the BULLETIN for March, 1907, p. 143.

Brückner: "Bakui informs us that early in the fifteenth century the sea swallowed up a part of the former city of Baku, and that in his time the water stood at the level of a still-existing mosque. Apparently we here have to do with an expansion of the sea and a subsequent standstill." The mosque stands sixteen feet above Brückner's zero.

In spite of Shah Rukh, one is inclined to doubt whether the whole stream of both the Oxus and the Jaxartes ever entered the Caspian, leaving the Aral to dry up entirely. At any rate, only fifty years later, in 1470 A.D., Said Abdul Hassan says that, "The River Amu, the great Jihun [Oxus], is the river which debouches in the Caspian Sea; it is also the Kharesm Jihun, which goes to Baheira Kharesm [the Sea of Aral]." Abdul-Ghazi, prince of Urgenj, or ancient Khiva, writing about 1632 A.D., gives a detailed account of certain changes in the Oxus. "In A.H. 880 [A.D. 1475] communication between Urgenj and the country of Abul-Khan [the Ust-Urtu plateau] was very frequent; because the River Amu [Oxus], after having passed under the walls of Urgenj, directed itself [along the Uz-boi channel] toward the eastern portion of the mountain of Abul-Khan, then toward the south following the base of the mountain, then toward the west. The river passed near Oghurja, and finally discharged its waters into the Sea of Mazanderan [the Caspian]." Again he says that in A.D. 1575, thirty years before his birth, "the Amu at Kara-Uighur-Tokai detached an arm [on the right] which passed the city of Tuk, and threw itself into the sea of Syr [Aral]. It was by this accident that the country of Urgenj has become a desert for lack of water. The place of the embouchure of the [new] river received the name Aral six months after the death of Essen [A.D. 1622]."

From the information given by Abul-Ghazi it is not clear whether the branch of the Oxus which in 1575 was diverted from Urgenj had formerly flowed to the Sea of Aral or to the Caspian. The account of Jenkinson, an English merchant who came down the Volga to the Caspian, and thence to Urgenj in 1559, indicates, however, that it flowed to the Aral. Jenkinson saw the mouth of the Uz-boi, and was told that formerly the Oxus discharged there, but had lately changed its course and gone back into the Sea of Aral. In coming to the Uz-boi, the Englishman sailed along the eastern coast of the Caspian near Mangishlak, and found deep water close to a shore where streams and trees abounded. To-day, as Rawlinson points out, the water is so shallow that no ship can approach the shore, and no one would think of describing the coast

as abounding in streams and trees. This suggests more abundant rainfall than at present, and a high stand of the water. It agrees with the atlas of Ortelius, dated 1562, which shows a deep gulf of the Caspian extending far toward Khiva—the Scythian Gulf once more.

After the days of Jenkinson the Oxus appears never to have flowed to the Caspian. Hanway in 1743, and later travellers, merely heard traditions of the drying up of the Uz-boi "a hundred years ago," or "long ago in the days of our fathers." Even before the time of Hanway, when Kitab Chelebi (Book Gentleman) wrote about 1650, the fact of the discharge of the Oxus into the Caspian was known only from books and tradition. Kitab Chelebi, commenting on the remark of Hamdulla (about 1359) already quoted, that the Oxus flowed partly to the Sea of Aral and partly to the Caspian, remarks: "There exists an arm of the Jihun [Oxus] which, after having passed the capital Khowaresm [Urgenj, or ancient Khiva], enters a narrow, rocky valley called by the Turks Kerlawā [the Kerlawān of Abdul-Ghazi]. This arm afterwards forms a cataract, where it falls with a frightful noise. According to Hamdullah, this arm of the Oxus discharges into the Caspian. Ebn-Haukal and Abul-feda [both about 1300 A.D.] say that the embouchure of the Jihun is in the lake of Aral, but we may believe that it is only the principal branch of the river of which those authors have meant to speak."

Kitab Chelebi speaks only as a commentator, and adds nothing to our knowledge or the relation of the Oxus to the Caspian, except in one respect. His mention of a cataract or rapids in the Uz-boi channel is in accord with what has been recorded by modern geologists. Several observers, to quote Davis, "have noted that the gentle southwestward descent of the channel is broken by the sills of rapids at several points, from which it may be inferred that the stream by which the channel was eroded did not endure long." Moreover, the Uz-boi channel is "decidedly smaller than that of the Amu to-day," from which it may be further inferred that it never carried the whole stream of the Oxus, and far less the combined Oxus and Jaxartes.

After the time of Jenkinson, A.D. 1559, the level of the Caspian still remained high, although, as we have seen, there is no evidence that the sea was re-enforced in any way by the Oxus. A sketch made in 1638 by Olearius shows that the sea stood then at the third tower of the wall at Derbent. Brückner says that, "according to Khanikof there is even to-day a clearly visible horizontal line of

disturbance, like an old strand, the same on which the sea of the representation of Olearius stands; and truly the great clearness of the line speaks for a very long stand of the water at this height." If the high stand of the water at this time were due to the inflow of the Oxus, which had come to an end over eighty years before, there could not possibly have been "a very long stand of the water at this height." Unless the climate were different from that of to-day, evaporation would have lowered the sea steadily year by year until it was reduced to its present level.

From the time of Olearius down to the present day, data as to the level of the Caspian become more and more abundant and trustworthy. As collected in Brückner's excellent summary, they show that there was a rather low stand early in the eighteenth century, followed by a somewhat higher stand till about 1820. Since that time the level has been low with many minor fluctuations, as is indicated in the diagram on page 581.

The evidence of the high stand of the Caspian Sea during the Middle Ages is so abundant that there is little need of citing the maps of the period. The majority were drawn in Europe, and are based partly on ancient and partly on contemporary materials. One shows a bifurcation of the Oxus; another shows the river as entering the Sea of Aral; and a third as entering the Caspian. The majority show an enlarged Caspian and no Aral. Humboldt says of them: "The maps of the Middle Ages, of which I have made a particular study, seem to indicate that the Scythian gulf of the Caspian [was] much more extended to the east than in our day, [and] has by mistake been made to include all the lake of Aral."

To sum up our conclusions as to the Caspian during the Middle Ages, there can be little doubt that the level of the sea has been influenced by changes in the course of the Oxus River. On the whole, however, the fluctuations of the lake do not correspond to the variations of the course of the river; and the influence of the Oxus appears to have been of minor importance compared to that of some other factor. At most only a part of its water ever seems to have reached the Caspian, and even that for only a few centuries from about 1200 to 1500 A.D. at the outside. The time is designated the "Oxus Period" in the diagram on page 581. It is probable, indeed, that the Oxus never flowed permanently to the Caspian, but only for a few score years at a time. As early as 920 A.D. the sea had attained a high level, but it was not till three centuries later that the Oxus was first diverted to it. Again, the last notable contribution of the river to the sea had come to an end before 1550,

but the sea remained at a high level till at least 1638. Thus it appears that the mediæval high stand of the Caspian was not due to the diversion of the Oxus, but to some other cause, and that cause appears to have been climatic.

If we accept this conclusion, the curve on page 581 may be interpreted as the climatic curve of the Aralo-Caspian basin. Except during the last two centuries the details are uncertain. There have probably been notable fluctuations of which we have no record. One such is suggested by the dotted line between 900 and 1200 A.D. If Brückner is right as to the date of the caravan-serai at Baku, a short dry period must have ensued after the moister period indicated by the account of Istakhri. Making due allowance for the defects of our knowledge, there remains a strong presumption that the Aralo-Caspian basin has passed through a double series of great climatic changes during historic times. During the period commonly called ancient, the climate was apparently damper and cooler than now. This first historic fluvial epoch gave place during the Dark Ages, Emerton's Transitional Epoch, to the first historic interfluvial epoch, during which the climate was warmer or drier than to-day. In the course of the next few centuries there was a change to the somewhat damper or cooler conditions of the mediæval fluvial epoch; and this in turn has been succeeded by the modern dry epoch.

The most significant feature of the climatic curve of the Caspian Sea is that it is applicable to the whole of western and central Asia. Two examples will show how the climatic hypothesis illustrated in the diagram throws light on and is confirmed by hitherto inexplicable phenomena of distant regions. Around the little lake of Son Kul, which we visited with the Kirghiz in the western Tian Shan Mountains, a thousand miles east of the Caspian Sea, Professor Davis and I found in 1903 the remains of a number of old irrigation canals. They were located on the mountain sides at an elevation of from 10,000 to 10,500 feet above the sea. As we concluded at the time, * "They must be hundreds, possibly thousands, of years old, since they are thoroughly graded, and are sometimes wholly obliterated for a space. They cannot be of extreme age, however, for many can still be traced throughout their entire length, although they lie across slopes of considerable steepness, where erosion is so rapid that such small features must soon be eradicated. They must be irrigation canals, for they contour around the hills, are broad enough to carry most of the water

* See the BULLETIN for Sept., 1905, vol. 37, pp. 529-530.

of the streams from which they diverge, and come to an end in places suitable for fields. The peculiar feature is that they lie at a great altitude, where there is now no agriculture, nor could be, it would seem. Snow falls at Son Kul, so the people say, during all but two months of the year. On the morning of July eighth, at the altitude of the upper canals, I walked on new snow which was said to have been a foot deep a few days before. The next morning, near the shore of Son Kul, below the level of the fields once watered by the canals, the ground was stiff with frost, and the little pools on the edges of the brooks were skimmed with ice. Moreover, if agriculture were possible under such conditions, irrigation seems unnecessary. In July the ground was saturated with moisture, and the natives told us that the grass is always green as when we saw it [in summer, at least]. The simplest hypothesis is that at some time since the human occupation of the country, the climate was warmer, and therefore drier than now; but this cannot be proved. In regions such as Transcaspia and Persia, there is strong evidence of a greater water-supply during antiquity. It is hard to reconcile the two sets of facts, but it may be that climate is more changeable than has been supposed, and that since the dawn of history man has passed through more than one change between colder and warmer, or moister and drier conditions. If this has been the case, the course of history must have been deeply affected by geographic causes as yet uninvestigated."

Now, in the light of three years' further study, it seems probable that the canals were built during the first historic inter-fluvial epoch, probably between 300 and 800 A.D. If the climate were then so warm and dry as is indicated by the low stand of the Caspian Sea, agriculture would have been possible, and irrigation would have been necessary in places like Son Kul which are now too cold and wet for either. The people who were forced out of the warm, dry lowlands by increasing aridity would naturally betake themselves to available spots in the highlands. They could not practice agriculture long at Son Kul, because the succeeding mediæval fluvial epoch caused the climatic conditions to become unfavourable once more at a high elevation; although at lower elevations the habitability of the country became much greater.

A second illustration of the manner in which the climatic hypothesis, as exemplified in the curve of the fluctuations of the Caspian Sea, throws light on difficult problems is found in Turkey. Two thousand miles west of Son Kul, the Armenian lake of Gyoljuk, twelve miles long by two or three wide, lies at an elevation of

4,000 feet among the Taurus Mountains between the headwaters of the Euphrates and Tigris rivers. In 1899 and 1900, when I mapped and sounded the lake, it overflowed throughout the year, and formed one of the most remote sources of the Tigris. Those years, however, were a time of unusually large rainfall, not only in Turkey, but in the continental regions of the world as a whole. In drier years the lake is said to have no overflow during the long, rainless summer. In 1879, which was also a time of comparatively large rainfall, Tozer records that the water had recently begun to overflow. During most of the last century, however, the lake must have stood at a lower level, for the natives are unanimous in saying that previous to 1878 the water—sometimes, at least—stood many feet below the present strand. The impregnation of the clear, blue water with borax also indicates that the lake has been without an outlet much of the time recently. The borax comes chiefly from some large deposits about three miles east of the lake. Its amount is not so great as to render the water undrinkable, or even distasteful, if one is thirsty; and animals drink from the lake freely. Apparently, under the present climatic conditions, the lake is on the dividing-line between a so-called normal fresh-water lake with a permanent outlet and a salt lake with no outlet.

In former times the lake of Gjoljuk appears to have fluctuated in size repeatedly, in the same fashion as the Caspian Sea, and the lakes of Seyistan, Lop, and Turfan. Deposits of sand and gravel, alternating with black, humus soil, bear witness to at least three pairs of successive fluvial and interfluvial epochs. These, probably, belong to prehistoric times. The first historic account of the lake is that of Ptolemy, in the second century of our era. He calls it Lake Thospitis, apparently equivalent to the name Dzopk, by which the Armenians still know it. He merely says that it lies four degrees—actually three—west of Lake Arsissa, the modern Van, and that the Tigris River flows from it, which is exactly what a modern geographer might say. Apparently the condition of the lake at that time was much the same as it is to-day.

Later, however, there appears to have been a change. Near the south shore of the lake there is a little island on which stand the ruins of an old Armenian monastery. Around it the stone houses of an ancient village can be seen, submerged in water to a depth of twenty or thirty feet. Local tradition, recorded in a book preserved, till the massacres of 1896, in a neighbouring Armenian village, relates that the monastery was built about A.D. 500, or 600, at which time the island was part of the mainland. The

present bed of the lake, so the record goes, was a cultivated plain, through the middle of which flowed a stream. The stream disappeared at the lower end of the plain, but reappeared beyond the mountains, where it joined the Euphrates. Gradually the underground exit was closed with silt, and the plain was converted into a lake. The reduced size of the lake at some historic period is proved not only by the old Armenian monastery, but by a line of old forts. The forts, which are from one to two thousand years old, plainly mark the course of an important road from Harput to Diarbekir, running directly across what is now the bed of the lake, at a point about four miles from its western end.

As to the supposed underground outlet, I could find no proof of its existence, though I searched diligently. Nevertheless, in spite of the improbability that a lake which had existed for ages, as is shown by its deposits in deltas and beaches, should be drained by a temporary underground outlet, which soon became clogged again, I accepted such an hypothesis in 1900 as the most probable explanation. The only alternative seemed to be the hypothesis of a change of climate, which I then thought "contrary to the facts of history." Now, however, I am inclined to believe that it accords with the facts of history. The fact that the fluctuations of Lake Gjoljuk agree so closely in time and character with those of the Caspian Sea, and that a single hypothesis explains both, gives good ground for believing that Turkey has been subject to the same changes of climate which have affected Central Asia.

The extent and possible significance of these changes will be manifest from a brief résumé of the main conclusions arrived at in this article, and in others published previously in the *BULLETIN* and in the *Geographical Journal*. Including Gjoljuk, there are thus far six distinct basins in which the evidence of climatic change has been investigated. On the west lies Gjoljuk in Turkey; then comes the Caspian basin in Russia, and that of Seyistan to the south in Persia; while far to the east we have Lop and Turfan in the heart of Asia forming part of China, and Kashmir south of the Himalayas in India. If we omit the Volga and the European portions of the Caspian drainage area, the limits of our six basins lie over sixteen hundred miles apart from north to south, and over three thousand from east to west. All this vast area seems to have been subject to the same great waves of climatic change.

In the ancient days, when the Oxus River entered the Scythian Gulf of the expanded Caspian Sea, and Lake Gjoljuk discharged permanently to the Tigris, the lake of Seyistan had not yet been

converted into dry land by the giants, as the legend runs. Kashmir was so cold and snowy that agriculture was impossible; its people, according to tradition, were nomads, who were obliged to drive their flocks southward in winter to the warm plains of India. In the Lop basin an opposite state of affairs prevailed, and conditions were highly favourable. The rivers were full of water; Lop-Nor was the "Great Salt Lake," the desert was comparatively small and the zone of vegetation extensive; and on all sides there was a density of population and a degree of prosperity far beyond those of to-day. And in the Turfan basin the same was probably true.

A great change took place throughout the six basins during the early centuries of the Christian era. The lakes of Gyljuk, Seyistan, the Caspian Sea, Lop-Nor, and presumably Turfan were greatly reduced in size. In the case of the first three, parts of the old lake-beds were utilized as sites for villages. Except in Kashmir, the change in climate appears to have brought disaster, although in Turkey the question has not yet been investigated. In the other regions scores of once prosperous oases were abandoned for lack of water. A few of the displaced inhabitants probably went into the mountains and dug canals such as those of Son Kul. Others, perhaps, went to Kashmir, which now became warm enough for agriculture, and hence able to support a far larger population. And the rest must have been impelled to start hither and thither in waves of migration to confound the civilized world.

Again there came a change. The process of desiccation gave place to a slight but important tendency toward increased rainfall and lower temperature. Kashmir became colder and more snowy, and hence more isolated; the rivers of Lop and Turfan gained greater volume; and the lakes of Gyljuk, Lop, the Caspian, and Seyistan expanded once more. The habitability of the arid regions began to increase; migrations came to an end; and Central Asia was prosperous for a time. Finally a latest and slightest change took place in the other direction, and we seem to-day to be in the midst of an epoch of comparative equilibrium, with no marked tendency toward climatic change in either direction.

OMAN AND EASTERN ARABIA.

BY

S. M. ZWEMER, F.R.G.S.

The growing importance of the Persian Gulf region in Asiatic politics is no longer a secret. Since the entrance of Great Britain through commerce and diplomacy early in the nineteenth century the Persian Gulf had become more and more an English lake, and the bulk of its foreign trade, amounting to about \$45,000,000 annually, was mostly in British hands. In the opening years of the present century, however, her supremacy has been challenged by both Russia and Germany—the former power striving for supremacy in Persia and aiming to secure a harbour at Bunder Abbas, the latter, through the Turkish concession of the Anatolian railway, planning an overland route to the East for German commerce. This road will have its terminus at Kuwait or Kozima, a splendid harbour on the Arabian coast at the head of the Gulf, while the total length of the line from the Bosphorus to the Gulf would be about 1,750 miles. The completion of this line would bring Busrah within ten days from Berlin and Bombay fifteen days from London.

The strategic importance of Eastern Arabia was thus described in a recent number of the *Pall Mall Gazette* :

It is the political future of Arabia and its people which forms the dominant keynote to the further development of the near Eastern question, now extending from the Caucasus to the Indian Ocean, and definitely embracing the great trade routes of the future between Europe and the East. Its position both on the flank of Persia and the sea route to India confers upon it a strategic importance which it is impossible to ignore in the struggle for supremacy in this part of the world, and there can be little doubt is destined to bring the country and its energetic inhabitants into a position of far greater prominence than they have enjoyed for centuries since the days of their victorious Caliphs.

Sixteen years of residence and travel in Arabia have afforded me opportunity to study the country and its inhabitants.

Eastern Arabia consists of the Turkish province of Irak or the river country, Hassa with the island group of Bahrein, and the region known as Oman. The latter is bounded on the west by the great unexplored tract of nearly 150,000 square miles area, known on our maps by the Arabs as *Robaa-el-Khali*, the empty abode. Although this vast area offers opportunity for geographical exploration and perchance archæological discovery, it is of no commercial importance, as most of it is utterly desert and uninhabited. Historically, politically, and geographically, Oman itself has always

been the most isolated part of Arabia, because, as far as outside communication with other Arabs is concerned, Oman was for centuries past an island, with the sea on one side and the desert on the other. The people are more primitive than Arabs in general. Only Maskat has its eyes open to the wide world; that is the only port in all Oman where steamers call. Ottoman rule never extended to Oman even under Suleiman the Magnificent; nor did any of the earlier caliphs long exercise their authority there. The whole country has for centuries been under independent rulers called Imans or Sultans. The population is wholly Arab or Moham-medan, and derived from two different stocks, the Kahtani and the Adnani—rival races at feud or war with each other.

The Jebel Akhdar region, or southern Oman, has been explored

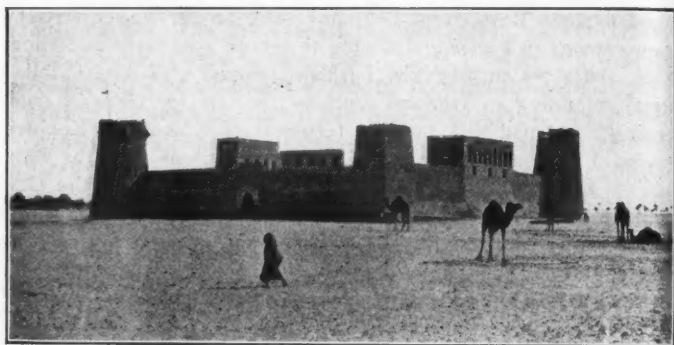


FIG. 1.—CASTLE OF THE SHEIKH AT ABU THABI, OMAN.

in part by Wellsted, Miles, Carter, and others. Northern Oman and the so-called Pirate coasts are less known. It was my privilege, while engaged in missionary labour, to visit this region on three journeys. The first was in May, 1900, when I crossed the Persian Gulf to Shinas and Sohar, on the Gulf of Oman, by way of Wadi Hitta. Afterwards, in February, 1901, I travelled along the Pirate coast, from Abu Thabi to Sharka; and the last journey, in May, 1901, was right across the north of Oman from Abu Thabi to Sohar by way of Bereimi. Abu Thabi (abu Debi) is the first town of importance on the so-called Pirate coast, and was settled some years ago by the great Beni Yas tribe. The town is under an independent ruler, Sheikh Zaid, whose influence is wide and strong over all the tribes inland as far as Jebel Akhbar. He is, however, as are all the tribal chiefs of the Oman coasts, under British protection.

The population of Abu Thabi is not over 10,000, and except a dozen Banyans from Sind, is wholly Arab or Negro (domestic slavery is still prevalent in all Eastern Arabia). With the exception of a dozen houses and an imposing castle, the whole town is built of date mats, and extends along the sea coast for nearly two miles. The only industries of the town and of all the coast are pearl-fishing and drying fish for export. On Ptolemy's map of Arabia this region is named Ichthyophagoi; and Niebuhr wrote, "Fishes are so plentiful on the coast and so easily caught as to be used not only for feeding cows, asses, and other domestic animals,



FIG. 2.—CAMEL EATING DRIED FISH AND DATES.

but even as manure for fields." His testimony is true to-day, and it is curious to see camels kneel down to their diet of dried fish!

About 80 miles north-east of Abu Thabi is the real metropolis of northern Oman, the growing town of Debai. In the "Persian Gulf Pilot" (edition 1890), the population of this town was given as 5,000; it is at least three times as large now. Between Abu Thabi and Debai the coast is desert, and so flat that a hill 225 feet high is called Jebel Ali (the high mountain). This is the only landmark on the coast, and visible 17 miles. The town of Debai has many houses built of native stone, and well plastered on the outside; the harbour is an inlet or *khôr*, and the town is built on both sides of this, so that ferry-boats ply between continuously, and the

place has a business-like aspect quite unusual in Arab towns. At present the rate of growth is such that Debai will soon outstrip all the other towns.

Sharka is still a Wahabi centre, although this Moslem sect has lost a great deal of its old fanaticism. The people of Debai, however, consider their neighbours heretics, and make sport of a rival bazaar where tobacco is still sold *secretly*; other Arabs are all inveterate smokers. Formerly this entire region was noted for the savage ferocity of its inhabitants. Forty years ago Sir John Malcolm wrote: "Their occupation is piracy, and their delight murder; they are monsters." Thanks to the British trade and influence in the Persian Gulf, these fanatic Wahabis have become tamed, and they have settled down in many places to begin agriculture. Young date-plantations are a sign of the progress of civilization, and commerce is crowding the nomad spirit out.

From Sharka the coast continues flat and sandy until you reach Ras-el-Kheima. The low, sandy coast with coral-rock formation, so characteristic of all the Arabian littoral from Kuwait down the gulf, ceases here and gives place to rugged headlands so well described by Moore in *Lalla Rookh* as:

o'er the Sea
Of Oman bestling awfully;
A last and solitary link
Of those stupendous chains that reach
From the broad Caspian's reedy brink
Down winding to the Green Sea beach.

Jebel-el-Harim, one of the chief peaks of these headlands, is 4,470 feet high, rugged, precipitous, and as naked of vegetation as are most of the peaks of Ruus-el-Jebel.

Ras-el-Kheima, the largest of the northern towns, was identified by Bochart and Sprenger as the Raamah of Scripture (Gen. x. 7, Ezek. xxxvii. 22), while the Greek geographers speak of it as Regma Polis. There are said to be ancient inscriptions on the rocks in the region back of the harbour, but I did not visit the spot. There is coffee-house talk in Eastern Oman concerning a mysterious race of light-complexioned people who live in the mountains somewhere, shun strangers, and speak a language of their own. I think I have found the clue to this strange story that has puzzled travellers to Maskat. At Khasab, near Ras Musandum, live a tribe whose speech is neither Persian, Arab, nor Baluchi, but resembles the Himyaritic dialect of the Mahras described by Carter (*Journal Bombay R. A. Soc.*, July, 1847). This language is used by them in talking to each other, although they speak Arabic with

strangers. Their complexion is, however, like that of the average Arab, and their religion Islam. Perhaps this is the tribe the rumours refer to and they are a remnant of the aborigines driven northward by successive Semitic waves of immigration reaching the highlands of Oman.

It may be of interest to note our mode of travel in this primitive country, where there are no beasts of prey but where every one goes armed for fear of his neighbour. I quote from my diary:

We travelled with as little baggage as possible, to avoid awakening cupidity on the part of any Arabs we might meet. There were only four camels in the caravan, and all our belongings in two Bagdad-leather boxes. At noon we rested under the shade of blankets stretched over our boxes; there was no vegetation large enough for shade. It was over 104 Fahr. in the shade one day, and the water in the skins took on a fine taste after hours of jerking on the camels. On our halts we made soup from condensed vegetables, and had dates for dessert, but our companions were afraid of tinned provisions; they much preferred boiled lizards and rice. There are two species of lizards in Eastern Arabia—one is called dabb (*uromastix acanthinurus*), and feeds only on desert vegetation; the other is called waral (*Weranus arenarius*), and eats insects, birds' eggs, etc. The latter kind is considered forbidden but the former lawful food. . . . Our guides proceeded mounted, but with their rifles loaded and cocked; then followed the baggage-camel, to which mine was towed in Arab fashion by hitching the bridle of the one to the tail of the other; in like manner, my companion rode his beast fastened to the milch-camel, followed by its two colts. We were not troubled by the heat at night, but during the day it was intense; and it was refreshing to come to an oasis where water burst from a big spring, and trees and flowers grew in luxury.

In the mountain passes of Oman the roads run almost invariably along the wadi-beds. Sometimes these are sandy water-courses with huge boulders; again deep, rocky ravines or broad, fertile valleys. Vegetation is fairly abundant. Tamarisks, oleanders, euphorbias, and acacias are the most common trees and shrubs.

The population of Oman is estimated at nearly one and one-half million. Very few of the tribes are nomadic; the greater part live in towns and villages along the wadi-beds, and were it not for continual feuds between the tribes, agriculture would prosper, as irrigation is nearly everywhere possible.

Every peasant goes armed, and one does not even pass a grey-beard riding a diminutive donkey without seeing a rifle, or at least a crooked dagger at his side. Yet, in spite of continual warfare, they cultivate every fertile spot assiduously, and raise all sorts of crops—barley, wheat, sesame, vegetables, and even tobacco. In one village we rested on the wide threshing-floor, where the old-fashioned "threshing instrument with sharp teeth" lay idle. The Oman plough is better than that of Mesopotamia, where they use a crooked stick with a sharp prong to cultivate the sandy loam. In this mountain region the law of the survival of the fittest has given the peasants skill in making a real coulter of iron, fitted to a heavy frame and braced to an upright handle of three bars set at right angles to the frame.

Maskat, the capital of Oman, and its metropolis, has been so often visited and described that it can be passed over.

Northwest of Oman the peninsula of Katar—low, barren, and unhealthy—projects itself into the Gulf, while the coast northward as far as Kuwait is known as El Hassa. Between Katar and the coast is the island group of Bahrein. The main island is about twenty-seven miles in length from north to south and ten miles in breadth. The total population of the group is about 60,000. The one great industry that makes these islands of importance is pearl-diving. The total value of pearls exported from Bahrein alone is estimated at one million five hundred thousand dol-



FIG. 3.—ROCK FORMATIONS AND CAVES AT EL JARA.

lars annually, and more than 900 boats are employed in the fisheries. The most primitive methods are used in diving. The divers wear no elaborate diving-suit, but descend clothed only in their *filaam* and *khabaat*. The former is a pince-nez or clasp for their nostrils, made of horn; the latter are metal thimbles or "finger hats" worn on the fingers of both hands to protect them in gathering the pearl oyster. A full account of these pearl fisheries can be found in my "Arabia, the Cradle of Islam," pp. 99-104. The Bahrein Islands came under the protection of Great Britain in 1867, when Sheikh Isa, the present ruler, was appointed. The trade of the islands has greatly increased, and to-day this is the most important

depot for export and import for all Eastern Arabia. It is the gateway to the interior, the threshold of which is the Turkish province of Hassa.

The usual route from Bahrein to Hassa is by way of Ojeir, a roadstead or landing-place for the caravan trade. In October, 1893, and again during the winter of 1905, I took this road to reach the city of Hofhoof, which is the capital of the province and held by a Turkish garrison. Ojeir, although it has neither a bazaar nor a settled population, has a fair harbour, a mud-fort, and an imposing Custom-house, and is therefore the landing-place for the immense quantity of Indian rice and Manchester piece-goods shipped by way of Bahrein into the interior of Arabia. Caravans of 500 or 1,000 camels leave every fortnight.

The country for some miles inland from the coast is desert, with ridges of sand and veins of greenish limestone cropping out at intervals. On the second day at noon you reach the oasis of Hassa, the palm forests which surround the capital and its neighbouring villages, giving it, as Palgrave says, "the general aspect of a white and yellow onyx chased in an emerald rim."

El-Hofhoof dates back to 570 A.D., and was for a long time the centre of the Carmathian sect which devastated large districts in Arabia during their fanatic raids. A relic of the old-time empire still remains in the celebrated *tawila* or long-bit, a copper coin in the shape of a horseshoe nail and worth about two cents!

But the whole of Eastern Arabia has suffered for centuries from the two enemies of progress—excessive taxation of agriculture and tribal warfare, so that on every hand there is little sign of progress. The country could be a veritable paradise under a stable government. It is a land of streams and fountains, subterranean but inexhaustible; and even now, with primitive schemes of irrigation, has wide fields of rice and wheat and extensive date-orchards.

The northern boundary of this fertile tract is at Katif, also a Turkish port. From Katif northward all the way to Kuwait the coast is barren and in the hands of the Bni Hajar tribes, who know neither Turk nor Arab as brother in their predatory warfare.

Kuwait, on the Gulf a little south of the river delta, will, in all probability, before long rise in importance, and be as well known as Suez or Port Said. It has the finest harbour in all Eastern Arabia, and is an important town of from 10,000 to 12,000 inhabitants. Here will probably be the terminus of the proposed railroads to bind India and the Gulf to Europe by the shortest route. The whole country round about being practically desert, the place is entirely

dependent on its trade for support. It possesses more buggalows (sailing vessels) than any port in the gulf; is remarkably cleanly; has some very well-built houses, and an extensive dockyard for

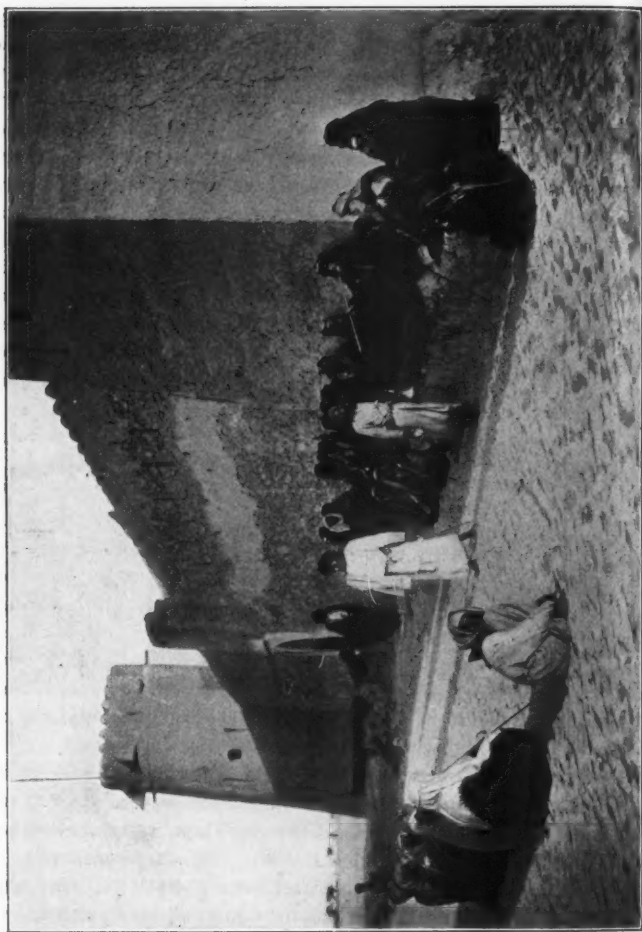


FIG. 4.—ARAB SHEIKH HOLDING COURT AT ABU THABI.

boat-building. The town and tribes are nominally under Turkish subjection, although protection is the better word, and it is rumored that Kuwait will soon be as much in the hands of the English as is Bahrein.

Ancient Busrah, near the present site of Zobeir, was founded in 636 A. D. by the Second Caliph Omar as a key to the Euphrates and Tigris. It reached great prosperity, and was the home of poetry and grammatical learning, as Bagdad was the centre of science and philosophy. After the twelfth century the city began to decay, and at the conquest of Bagdad by Murad IV, in 1638, this entire stretch of country fell into the hands of the Turks. Then the present city took the name of Busrah. Later it was in the hands of the Arabs and Persians, and from 1832 to 1840 Mohammed Ali was in possession. Under the rule of Midhat Pasha, Governor-General of Bagdad, the city of Busrah arose in importance, partly because of the Turkish Steam Navigation Company, which he promoted. But it was a dream-life. English commerce and enterprise aroused the place thoroughly, and the whistle of the steamships has kept it awake ever since the Suez Canal opened trade with Europe by way of the Gulf.

The two Turkish provinces of Bagdad and Busrah are known commonly by the name of Mesopotamia. It is called by the Arabs El Jezira, and was formerly limited to the land lying between the two rivers and south of the old wall by which they were connected above Bagdad. From this point to the Persian Gulf the district was and is still known as Irak-Arabi, to distinguish it from the Irak of Persia. Commonly, however, the name of Mesopotamia (Mid-River-Country) is given to the whole northeastern part of Arabia. It has a total area of 180,000 square miles, and presents great uniformity in its physical as well as its ethnical characteristics. Arabs live and Arabic is spoken for three hundred miles beyond Bagdad as far as Diarbekr and Mardin; but we limit our description to the region between Busrah and Bagdad, including the delta at the mouth of the rivers.

Near Bagdad the two giant rivers, after draining Eastern Asia Minor, Armenia, and Kurdistan, approach quite near together; from thence the main streams are connected by several channels and intermittent water-courses, the chief of which is the Shatt-el-Hai. At Kurna the two rivers unite to form the Shatt-el-Arab, which traverses a flat, fertile plain dotted with villages and covered with artificially-irrigated meadow-lands and extensive date groves. As far up as Bagdad the river is navigable throughout the year for steamers of considerable size. It is entirely owing to the enterprise of English commerce and the Bagdad-Busrah steamship line that the country, so gloomily described by Niebuhr in 1792, and even by Chesney in 1840, has been developed into new life and

prosperity. Even Turkish misrule and oppression cannot do away utterly with natural fertility and productiveness; and if ever a good Government should hold this region it would regain its ancient importance and double its present population.

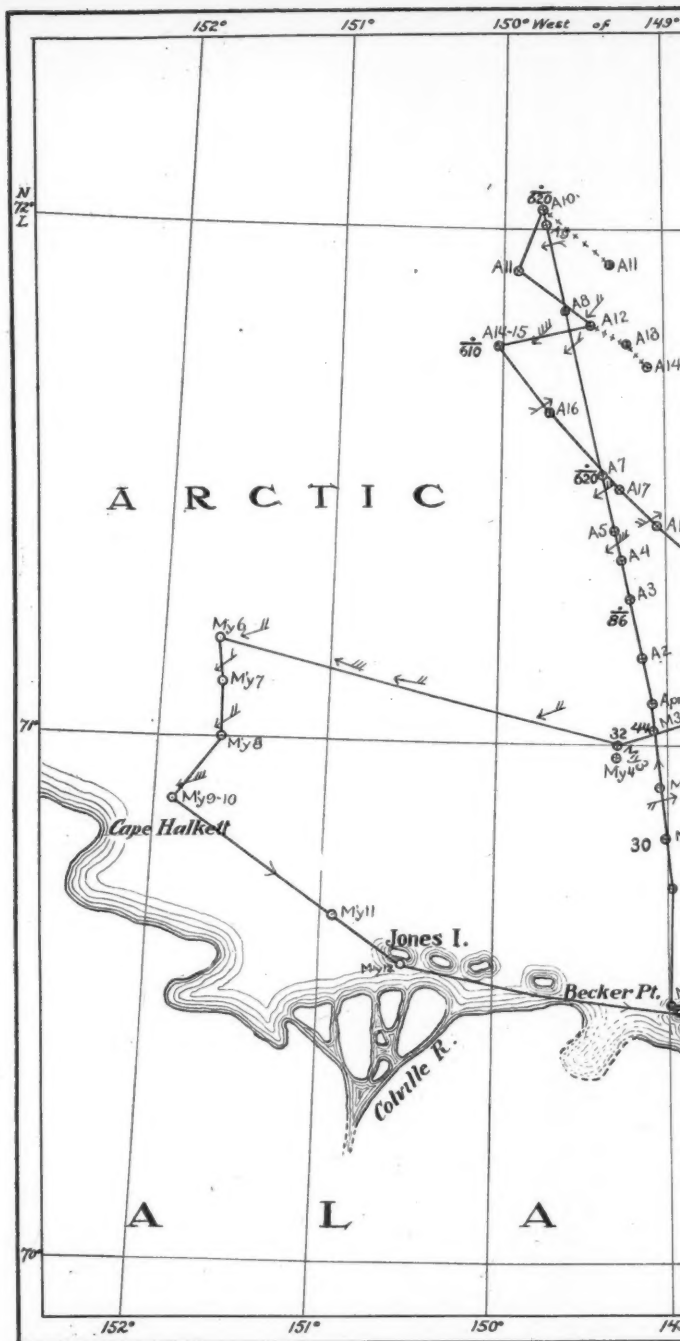
Two features are prominent in the physical geography of this region. First, the flat, almost level, stretches of meadow without any rise or fall, except the artificial ancient mounds. The second is the date-palm. The whole length of the country from Fao and Mohammerah to the country of the Montefik Arabs above Kurna is one large date plantation, on both sides of the wide river.

Some idea of the immense importance of this one crop in the wealth of Mesopotamia may be gained from the statement of an old English merchant at Busrah, that "the annual date-harvest of the River-country might conservatively be put at 150,000 tons."

What is to be the future of this great and wealthy valley, which once supported myriads and was the centre of culture and ancient civilization? Will it evermore rest under the blight of the fez and the Crescent? The one curse of the land is the inane Government and its ruthless taxation. The goose with the golden egg is killed every day in Turkey—at least robbed to its last nest-egg. The shepherd tribes, the villages, the nomads, the agricultural communities, all suffer alike from the same cause.







of 149° Greenwich 148° 147° 146°

SKETCH MAP
SHOWING
ROUTE OF SLEDGE PARTY
DURING
SPRING OF 1907
BY
Ejnar Mikkelsen

- COURSE BETWEEN OBSERVATIONS WITH CAMPS.
- - - - - COURSE AND CAMPS ACCORDING TO DEAD RECKONING.
● A21 DATE OF CAMPS.
63 DEPTH IN METERS
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220
← LENGTH OF LINE OUT AND NO BOTTOM
← WIND (DIRECTION AS ARROW POINTS) 5 MILES PER HOUR
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REPORT OF THE MIKKELSEN-LEFFINGWELL EXPEDITION.

Early in September, Mr. A. H. Harrison, returning from the Arctic coast near the Mackenzie delta, brought the rumour that Captain Mikkelsen and Mr. Leffingwell, joint commanders of the Anglo-American Polar Expedition, had been away for more than two months from their camp at Flaxman Island making a sledge journey over the sea ice; as they were overdue and one or more of the dogs had returned, it was feared that the explorers were lost.

Happily, this ill-founded report was almost immediately contradicted by a despatch to the American Geographical Society from Mr. V. Stefansson, ethnologist of the expedition, who was on his way home and telegraphed from the first station he reached in Alaska. On Sept. 12, the Society received a longer despatch, signed "Mikkelsen-Leffingwell," summing up briefly the important results of their remarkable sledging expedition. Mr. Stefansson also mailed to the Society from White Horse, on Sept. 17, the detailed report, prepared by Captain Mikkelsen, of the sledge journey and the other work, past or prospective. The full report and the map and diagram accompanying it are here presented*:

"The facts I have to tell show that good and bad fortune have mingled in our experiences. We have lost our vessel, the *Duchess of Bedford*. She sprung a leak at Flaxman Island on Jan. 27 this year, and from that time, as long as she was afloat, the pumps were going almost incessantly. The leak was probably caused by the pulling out of the caulking, which the ice around the vessel had permeated. The ice contracted, drawing away from vessel and leaving cracks along her sides.

"Fortunately, with the aid of the Eskimos, we got our stores ashore without serious loss. From the beginning of the trouble till April 3, when we decided to abandon the vessel, the fore-castle floor was flooded many times. Meanwhile a house was built ashore from lumber broken out of the ship. On April 11, the crew moved ashore and the ship filled rapidly. Dr. Howe, who was left in charge of the ship while we were sledging on the sea ice to the north, did not break her up, and if she could have been repaired we might have done so when we returned. But she could not be saved, and on May 17 we began to break up the hull in order to get more building material.

* This report is not dated. It was evidently sent from Herschel Island about August 1.

"The loss of the ship makes it impossible for us to proceed east to Banks Land; but this does not seem now to be important, as our discoveries this spring on the sledging expedition make the crossing of Beaufort Sea, from Banks Land to Point Barrow, of questionable value.

"Owing to the very severe weather, we were not able to start over the sea ice until March 3. We set out with five men, two of whom were a supporting party. We had supplies for 85 days and carried material for a raft. Of the seventeen dogs we had purchased, some had died and only six were worth taking out on the ice. We therefore had to buy a few dogs from the natives at high prices. They were strong animals, average weight 73.3 pounds, and the thirteen dogs we took out pulled three sledges.

"The land floe which formed last fall had been broken up on Jan. 13 by a heavy W. S. W. gale. When it froze again, it was continually rebroken by frequent westerly gales. At the time we started, it consisted of large fields of young ice, with some heavy pressure ridges.

"We made about seven miles on the first day, but camped early on account of an open water lane, too wide to be crossed. It froze over during the night and on the two days following we made small headway (only about 3 miles) over heavy, old ice, being stopped repeatedly by open water lanes. On March 6, we entered an area of very heavy rubble ice [fragmentary ice] with deep, soft snow between the fragments. From a height of 30 feet, no smooth ice could be seen. The ice surrounding us consisted of an almost fresh, whitish ice, with thinner and more salty ice on top. It was intersected by long lanes, about 6 feet deep and 4 feet wide, with sides perfectly perpendicular. The face of the break was smooth and showed the two layers of ice distinctly. It looked as if an enormous mass of young ice, one to two feet thick, had been forced up on top of very thick ice, or heavy rubble, and was broken by the process into small pieces. We worked for 5 hours with pickaxes and shovels to make a road, and hewed our way for about 200 yards. Then we dragged the sledges, with three men to a sledge, about 75 yards, when we were obliged to abandon the attempt, as our sledges broke down, being too frail and too heavily loaded for such rough ice. We returned to the ship on March 7.

"Stormy weather delayed our second departure until March 17, when we started with food for 65 days, and a total weight on the sledges of 1,226 lbs. In addition, we carried food enough for men and dogs while travelling on the lagoon ice [between the chain of

islands and the Alaskan mainland] and one week's food to be cached for our return trip. The party consisted of Mr. Leffingwell, Mr. Storkersen and myself.

"We had very bad weather immediately after our departure, and spent nearly three days in the tent. The ice off Pole Island was worse than off Flaxman Island, so we kept on to Cross Island, but were defeated in our efforts to find passable ice there on which we might get north. We decided to make one more attempt further to the west.

"We struck seaward from a small sandspit at about 149° W. Long. on March 28, and found very much better going than we had expected. The land floe extended about 4 miles off land, was level, and from ridges at its outer edge we saw to the north of it large fields of young and level ice. They extended further than we thought they could and we made very good headway. The ice was only about six inches thick. We travelled about fourteen miles the first day. As we advanced northward, we had stretches of bad ridges, on which we had to work hard with our pickaxes, without which we could not possibly have made any headway. Now and then we encountered extensive lanes of young ice, all parallel to the coast, and sometimes so thin that the ice bent under us. Travelling became worse as we advanced further from the land, and some days we only made 3 miles in ten hours. The ice consisted of last year's heavy floes, with pressure ridges and lanes covered with thin ice. Luckily, temperature was rather low (between -30° and -40° C.), so that new lanes froze over rapidly. Large rubble with soft snow between caused much trouble, and delayed our progress. Our teams were not strong enough to pull the sledges alone, so we had to pull steadily in soft, deep snow, through which it is very tiresome even merely to walk. The dogs at times sank so far in that they could do no pulling, and the crossbars of the sledges often dragged through the snow.

"The further we penetrated north, the more floes of old ice we encountered, but they were not at first very heavy or extensive. This ice is quite distinctive and we were inclined to call it palæocrystic, but, to avoid confusion, it will be denominated here simply old floes. The ice consists of very old floes, with rounded-off hummocks, the whole covered with snow of a yellowish tint, making the floes distinguishable for a great distance. The ice is perfectly fresh, and, where seen in section as exposed by breakages, it is of the same blue colour as glacier ice. The highest hummocks were about 30 feet above water level. The old floes gave us, as a rule, very good travelling.

"Up to April 3, we made some headway every day, though it was hard going, either deep soft snow or heavy pressure ridges over which we had to hew a road. From the first day out, the pickaxes were in constant use. We could not have advanced without them, as our sledges would have broken down, and, even with the greatest care both in making roads and in driving, we had to strip the under-runners from one of the sledges. On April 3, about 43 miles from land, we came upon the same kind of ice, that had stopped us off Flaxman and Cross Islands. It did not extend very far, and had within it some very small stretches of passable ice, but nevertheless, it took us five hours to cover less than 500 yards.

Just beyond this zone of bad ice, we came to the largest body of old floe we had seen thus far, and we made splendid headway. Up to this time, we had taken two soundings of 30 and 44 meters, and then we found, to our great surprise, 86 meters and no bottom, a couple of miles to the north of the heavy rubble. Our sounding-machine had not yet been rigged for work.

"The ice we crossed on the following day was heavy, but the ridges, as well as the blocks in the heavy rubble, were further apart so the wind could beat the snow hard between them, and we had floes, a mile or so in diameter, of flat-pan ice, and some of the old floe. Altogether, we made fairly good headway; but though we were very careful in estimating our daily marches, still each observation for latitude showed that we had underrated it; and yet our lead line had failed to show any appreciable drift.

"On April 7, about 64 miles off land, and 31 miles north of our last sounding with bottom, we took a sounding with the sounding-machine, and found 620 meters and no bottom. We had not expected to find such deep water so close to shore, and had not improved every opportunity to get soundings; but this deep sounding probably indicated that we were beyond the edge of the Continental Shelf. We thought there was a possibility that the sounding was taken over a submarine valley from the Colville River, and both Mr. Leffingwell and I were anxious to get further out, especially to see whether we should strike a pack of heavy and continuous old floe.

"We were disappointed that we had not fixed the edge of the Continental Shelf, if we had passed it, and if not, we were anxious to find the other side of the valley. We took several soundings, but with no better fortune. There was no drift visible on the lead-line, even when all the line was out (620 meters). But on April 9 we took our first longitude, and found that we were 20 miles to the west

of our starting-point, although, according to our dead reckoning, we should have been to the east of it. We had been believers in the generally-accepted idea of a practically immovable pack in these waters, and so had not given much attention to our longitude. But it was now evident that we had drifted to the north as well as to the west, and this accounted for the supposed underestimation of the daily marches.

"During the last few days we had, to a great extent, travelled over the heavy, old floe, and had made fairly good headway. The floes were not continuous, the largest being only about 2 miles in diameter; but they were either fairly close together, at many times separated only by a pressure ridge, or there were fields of old pan ice between them. On the western side of most of the larger bodies of old floe we found a lane, sometimes more than a half mile across, and covered chiefly with thin ice. We had only twice seen the ice in motion. Once we were stopped by a lane for more than an hour and a half, waiting for the pressure and motion to subside. On the other occasion the pressure continued only for a short time; but it was heavy. In both cases the wind was W. S. W. (true) above 10-15 miles per hour.

"At one time, while crossing a very thin stretch of young ice to the west of a large body of old floe, pressure began and lanes opened while we were in the middle of the ice. We had to work very hard to regain more solid footing; and this was not easy when we had to drag heavily-loaded sledges on wooden runners over the newly-formed ice. If our runners had been equipped with steel shoes, we could have made somewhat better progress. German silver is too soft for work in such heavy ice.

"On April 10 we came unexpectedly upon a great number of cracks, some so wide that we had to make long detours to find a crossing; others, not too wide to take the sledges over them. There had been no differential motion in the ice, as every point on one side fitted into a bay on the other; and it was the same twenty-four hours later when we returned over our old tracks. We kept on for two miles or so; but at last had to camp, as the floes were becoming smaller and smaller. The weather was rather thick; but we could see no end to the lanes, and over the northern horizon hung a very heavy water-sky.

"We began to realize that we were working without furthering the object of the expedition, as there could be little doubt now that we had passed the edge of the Continental Shelf. We were 32 miles north of the place where we first got 620 meters and no bottom,

so that the chances of the depression being a submarine valley were very small. We decided to return and to travel S. E. until we came into soundings again and then follow the edge of the shelf as far east as possible (lat. $72^{\circ} 0' 2''$ N.).

"After we began heading S. E., we were continually stopped by open and sometimes wide lanes, not yet covered with ice. The wind was light easterly. We now took, if possible, at least one time-sight a day, so as to be able to judge the drift. The first day's journey took us a little to the west of our starting-point, although the course had been S. E. and easterly; but the next day's observation corresponded very well with the dead reckoning, as the day had been calm. The wind blew up again from the E. N. E., about 20-25 miles per hour, but we made fair headway true S. E. over extensive fields of the old floe for two days, until we were stopped by a wide crack, where we found no crossing. The sun had not been visible, and we did not get a time-sight before the afternoon of April 15. It gave the unpleasant result of $150^{\circ} 01' W.$ Long. (average of two observations). Thus, instead of making twelve miles to the S. E., we had gone thirteen miles W. by S., with a difference between observation and dead reckoning of nineteen miles in longitude and five miles in latitude.

"From April 15 to 19 we had good travelling over the old floe, with thin ice interspersed. This was rather broken up, and at one place we passed 23 newly opened lanes, from 1 to 10 feet wide. They had opened very recently, as there was no ice on the water, though the temperature was $-20^{\circ} C.$

"The wind had been W. S. W., 5 to 10 miles per hour since our last observation, and when we again had the luck to get a time-sight, it put us six miles to the west of dead reckoning, which showed that the ice had been drifting against the wind.

"The next day was spent in camp, as we desired to find the drift when a W. S. W. wind, with a force of 20 to 25 miles per hour, was blowing. A time-sight twenty-four hours after gave a drift of three miles to the east. The ice was pressing heavily all around us and we could hear far and near the grinding noise it made.

"We took soundings whenever a chance occurred, and knotted on to the 620 meter wire what spare line we had, making a total of about 690 meters; but still we could not get bottom, and that within 16 miles of the latitude, where we found bottom at 44 meters. Sledging now became a little worse, and we travelled over ice made for the greater part last fall, but badly broken with ridge after ridge extend-

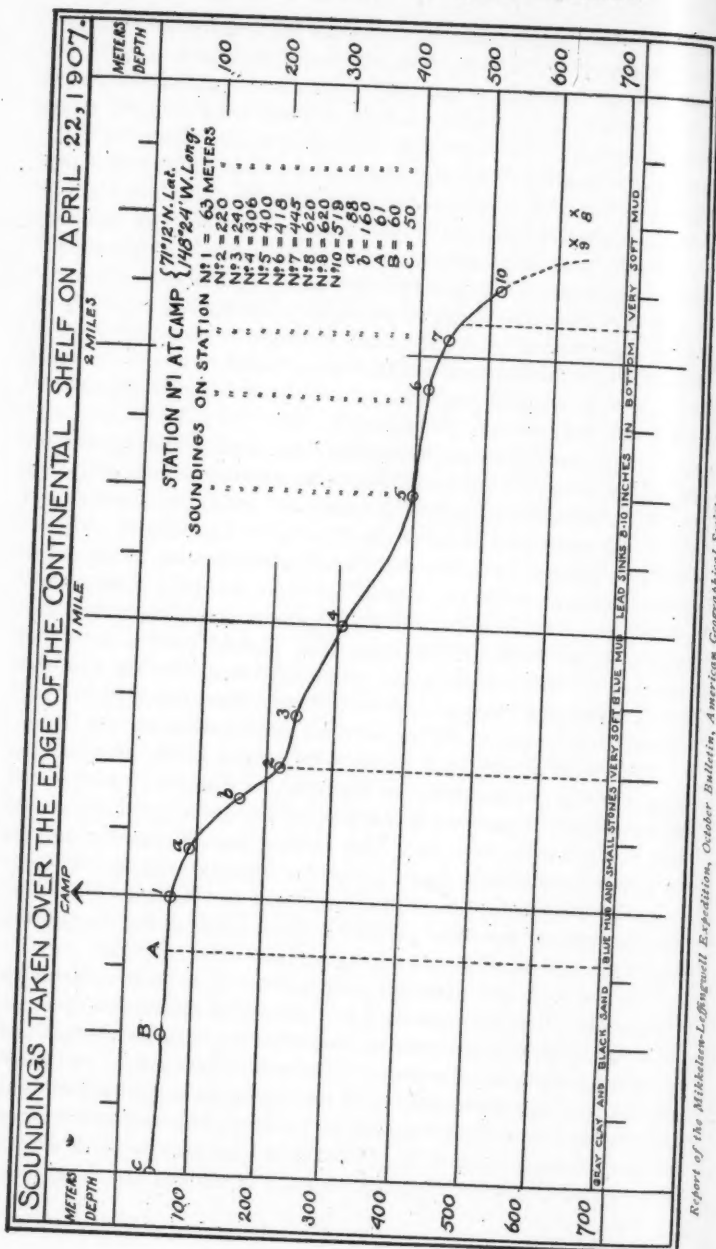
ing across our course. We witnessed the formation of several pressure ridges. Wind light westerly, five to ten miles per hour.

At last, on April 22, we got a 63 meter sounding, four miles south of a sounding of 620 meters and no bottom. We camped on the spot, and ran a line of soundings out, north and south of the camp, so as to get the slope as exactly as possible. At a depth of 88 meters there was a sudden drop to 220 meters in three-quarters of a mile. Two and a quarter miles north of the camp we had our last sounding, 519 meters, and 200 yards further out 620 meters and no bottom. Landwards we made a sounding at 50 meters, and were then stopped by a wide crack a mile south of the camp. On the last sounding we had the misfortune to lose our lead, as the wire snapped. Thereafter our light pickaxe was utilized as a lead, but it was not quite heavy enough. In 35 hours the soundings on the very edge of the deep slope increased only three meters.

"On the morning when we left this camp a wind sprung up from E. S. E., about six to eight miles per hour, and our sounding through the hole where before we had obtained 88 meters increased to 171 meters. A strong set of ice to the W. N. W. was visible. The ice opened up in lanes, and moved fast both with reference to the neighbouring floes and to the sea bottom, but there was no pressure worth mentioning. The ice we travelled over was from one to two feet thick, and had, within a few days, been pressed up into very high ridges. That this pressure was recent was shown by the fact that the salt water and slush on top of the floes, where the upheaval and pressure had depressed the ice near the ridges, were not yet frozen.

"The actual drift was, however, not very great, as observations placed us only one to two miles further west than our dead reckoning for one day's march. The wind was E. S. E., with a force of three to eight miles an hour. The weather became warmer, and on April 26 it was for the first time above freezing, making the snow still softer than before and water ran from the blocks of ice. The travelling was bad, we saw very little of the old floe, and the ice was very much broken, so that our progress was slow.

"On this date we used our raft for the first time in ferrying across a lane, about 100 yards wide. As we became more expert we could rig up the raft, ferry all our outfit across, load the sledges and be ready to start in 65 minutes. The raft was made of two nine-foot sledges, lashed together with two heavy poles, the frame thus made being covered with a piece of canvas. The raft could carry an 11-foot sledge with a load, a total of 320 pounds, with a man sitting astride, in order to pull it across. There was not much free-



board, to be sure, and we had to move carefully to keep the raft from swamping, but we had no mishap. The total weight carried extra to construct the raft was 22 pounds, of which 14 pounds was the cover. This was useful as a tent cover, and it made the tent warm and comfortable.

"The going became worse and worse, and whenever we were not travelling over the old floe (and this was rather scarce now), we had ridge after ridge, or heavy rubble, with deep, soft snow. A still worse hindrance to progress was the numerous lanes, now covered with a thin coating of ice, too thin to walk over and too thick for the raft. On April 27, we reached by far the largest body of water we had yet met, and it opened still more during the night. There was considerable differential motion in the ice now, and by travelling along the edge of the wider lanes we usually found a crossing; but it took a long time, and the going between the lanes was exceedingly bad.

"At one time, we brought up against a lane, which, at the widest, was at least a quarter of a mile across, and over which we could find no crossing. From a high ridge we saw an endless number of smaller cracks, running into a larger one to the east of that which had stopped us, and no crossing could be seen over any of them. The headline showed a rapid drift to the W. N. W., and we could not get bottom with a 520 meter line. The wind was E. N. E., about 15 miles per hour. Observations gave the discouraging result that, instead of going two miles to the E. S. E., our position was one and a half miles to the west and north of the preceding day's observation. Two of our sledges were very rigid, and we might expect a complete breakdown of either of them at any time. Our lead was lost, so we could not take soundings in deep water, and last, but not least, the permanent easterly winds with warm weather, and stronger drift to the west than we could neutralize by walking to the east, made it only too evident that we could do no more here, but had better try to reach land, an undertaking which was considerably more difficult than we had expected.

"The return march began on April 29, lat. $71^{\circ} 17' N.$, and long. $147^{\circ} 44' W.$ Unluckily, we lost our heavy pickaxe the first day. It slipped through thin ice, and our small one was too light to be of much use in the heavy ice. This pick, too, we lost two days later by the breaking of the sounding wire. The loss of the pickaxes caused us considerable extra work and many delays. It was plain to us that we could not have done anything whatever without them. Next year we shall carry two heavy ones.

"We came into soundings again in 56 meters, two miles to the south of our camp, and had a strong westerly set. The walking was very difficult, the snow was soft and deep, and there were many cracks; but our sledges were light, and we made comparatively good headway, five miles true S. S. E. However, when we had calculated our observations, they gave our true course to be W. S. W., and distance 12 miles—a rather discomfoting discovery, as we had not expected that the very light E. N. E. wind which had blown that day could have put us so much out. It was thick and cloudy weather the following four days, and our road lay through very heavy rubble and deep snow. Besides, we had many wide cracks to pass, and, by way of variety, were often compelled to crawl over pressure ridges so steep that we at times had to unharness the dogs and lift the sledges over bodily. For two days we had been heading toward three very high-pressure ridges, and, to get a good lookout, we climbed the lower one, which was at least 35 feet high. The cracks were wide, sometimes as much as 200 yards, but were full of small pieces of ice and slush, so that a man could cross most of them by jumping from one ice-cake to another. The slush was pressed together sufficiently to carry a sledge, if it were hauled rapidly, so that we took the sledges over one by one. Sometimes, however, our whole outfit was on a small cake in the middle of a wide crack, when a motion in the ice made further progress impossible, and we were for a time obliged to remain on it, as we could neither get back nor forward. The sledges often upset while shooting over the slush, and sometimes we barely missed losing a sledge and outfit, but nothing serious happened.

"Now and again we were able to get a longitude which always gave the same result—rapid drift to the west; but, as the sun was not visible at noon for six days, we were rather in the dark as to our latitude. When we finally got an observation on May 5, we found that we had been carried 71 miles to the west of our observation on April 27; and although in that time we had made about 14 miles southing, our latitude was the same.

"On May 6 we came to the largest body of water we had seen; and as we could not get around it, we had to wait for a day. In one place we could barely make out the edge on the other side, from a height of at least 25 feet. However, with so rapid a drift, the water-lane changed continually, and, by travelling from floe to floe, we reached on May 6 the edge of the pack ice. The motion was greater here than anywhere else, and, in crossing a wide lane, our tracks were displaced 150 feet in the time it took us to cover 75 feet.

"The southern edge of the pack ice was anywhere from 200 yards to a quarter of a mile away from the solid land floe, and the water was perfectly open. We had to camp and await the arrival of a big floe, on which we might cross, or for the crack to close up. The latter happened during the night, or, rather, the piece of ice on which we were camped broke loose and floated over.

"While we were waiting we had ample opportunity to watch the abundant animal life in or along the crack, in which seals were continually showing themselves. A bear, also, came close to our camp; and as we did not know how long we might have to remain in that place, it was shot for food. Ducks were seen in immense numbers, flying eastward along the crack, and we counted at one time ten flocks with at least a hundred in each. Sea gulls also were very abundant. During the entire journey over the pack we saw seals whenever we had open water, and bear tracks were numerous. Many fox tracks, too, were seen, but comparatively few close to shore. They were most abundant about fifty to seventy miles off land. One day we counted 23 fox tracks.

"The place where we finally got across to the land floe was filled with very bad ice, and we had heavy rubble with soft, deep snow until we struck the lagoon ice on May 9. We partly followed the mainland, partly the sand spits which extend along the coast, and arrived at our camp on May 15.

"On the trip we made altogether 533 nautical miles, lagoon ice and drift included, in 60 days; 361 miles of this was over the pack ice. Our average daily marches going north were 6.7 miles; heading S. E., 7.2; and southward to the lagoon ice, 2.4 miles.

"The results of the sledge expedition were not what either Mr. Leffingwell or I had hoped or expected. The conditions of the ice in Beaufort Sea were of an entirely different character from those that had been conjectured to exist. We found the edge of the Continental Shelf, and established beyond a doubt that there is a strong drift to the west with easterly winds, and hardly any, or none at all, to the east, with westerly winds.

"The old floe, which has not been reported as found to any extent outside of Beaufort Sea, gives to those who see it the impression that it is formed in a land-locked sea, and it must be exceedingly old. It certainly is of an entirely different character, and considerably older than the ice which drifts across the polar ocean, and comes down the east coast of Greenland, which I saw while serving in the Amdrup Expedition of 1900.

"An obstruction to the eastward seems to be necessary to explain

the rapid drift to the west before an easterly wind, and very little, or none, to the east before a westerly wind. But if the Continental Shelf does not trend considerably further from land than we found it (about 43 miles) and that not far to the east of where our course lay, there can hardly be room for any new land, as we know that steamers have been far to the north of Herschel Island. Last fall, for instance, the steamer *Narwhal* was almost 200 miles to the north of that island. Soundings north of Herschel Island seem to indicate a narrow Continental Shelf there, too; but as only a few soundings have been taken, they may be in the submarine valley of the Mackenzie River. If they are on the edge of the Continental Shelf it must run almost parallel to the coast, and not parallel to the coast mountains, as one might have supposed.

"The Eskimo reports concerning land to the north of Pt. Barrow and the reports about the island which Captain Keenan and several Eskimos thought they saw somewhere to the north and west of Harrison Bay, related probably to the heavy floe, which, seen in a certain light, conveys the idea of distant land. The fact that the Eskimo reports tell about "rounded-off hills" on the land they claim to have seen or visited strengthens this idea, for the old floe has many of these rounded elevations.

"From early fall until January 1, 1907, we took hourly tide observations at our camp and, for three days, at Icy Reef and Pole Island.

"The meteorological observations were kept up without interruption, and Mr. Leffingwell obtained several astronomical observations. In addition to this work, he followed the coast from Flaxman to Herschel I., and made many corrections in the map, some of them of much importance.

"Two days after our return from the sledge expedition he left again for the mountains inland, where he is making surveys and studying the geology of the region.

"Mr. Stefansson, our ethnologist, who went down the Mackenzie River, arrived at Herschel I. at the appointed time; but when the ship failed to come, he went to live with the Eskimos in order to learn their language and begin his ethnological labours. He travelled back and forth with them, and went as far east as Toker Point [E. of the Mackenzie delta and about 160 miles E. of Herschel I.]. He has obtained many anthropological measurements, and acquired a good knowledge of the language. As he had no trading material, he was not able to make any collections there. In the spring, he went to Herschel Island and heard from a whaler wintering there

that we were at Flaxman Island. He reached our camp while we were absent on the sledge journey. As his affairs called him again to Herschel I., he went back there with trade goods, but returned here on May 17. Since then he has made investigations in this neighbourhood and has collected old specimens of Eskimo handiwork in various parts of the island.

"Our natural history collections are small, as Mr. Ditlevsen, who was to attend to that branch, became ill, as already reported, and was compelled to leave us at Port Clarence on our way to this coast.

"As to our future work, Mr. Leffingwell will survey late this fall the chain of sand spits extending westward from here. When the whalers arrive this season, I intend to go to the east with one of them, and either take soundings from the vessel itself, while on the whaling ground, or make a cruise in the whale boat. I shall try to get a line of soundings from Cape Parry (Canada) to Nelson Head (Banks Land) and from Cape Kellett (Banks Land) westward as far as the ice will permit. I shall then return to Herschel Island and spend what time remains this season in making soundings to discover the extent of the Mackenzie submarine channel. How much of this programme can be carried out will depend upon the ice conditions.

"Next spring a sledge party will start from Demarcation Point [about 50 miles west of Herschel I.] and work northward until it gets soundings in 1,200 meters and no bottom. It will then work southward to the edge of the Continental Shelf and follow it westward. How far the edge can be traced will depend on the ice conditions; but if the westward drift proves to be as strong as it was this year, Cross Island will probably be reached. Survey work will also be carried on along the coast next season until it is time for Mr. Leffingwell to go inland in order to continue his surveys among the mountain ranges.

"If nothing unforeseen happens, we intend to go further east in a whale boat in the fall of 1908, carrying as much food as possible; and we plan to spend the fall and winter somewhere off the mouth of the Coppermine River, where there will be survey and ethnological work to do. In the spring of 1909 the party will return to the Hudson Bay post and reach the United States in the early fall of that year."

During his journey home Mr. Stefannson sent a despatch to the *World* from Yukon Crossing. It was dated Sept. 14, and in it he said:

"At Herschel I. we learned of the mistaken report sent via Hudson Bay Company's MacKenzie steamer regarding the loss of the ice party.

"I volunteered to try to reach some telegraph post in Alaska, whence a contradiction of the report could be despatched. I went to Fort MacPherson by boat, walked over the mountains for six days to reach Bell River, and floated down it alone to Fort Yukon, where I arrived on Sept. 3, twenty-seven days from Herschel Island. Dr. Howe and the crew probably will arrive in San Francisco in November."

GEOGRAPHICAL RECORD.

AFRICA.

VARIATIONS IN THE LEVEL OF LAKE CHAD.—*La Géographie*, for March, giving the results of the military studies during 1906 of the Lake Chad region, publishes notes obtained from the natives concerning variations of level in the lake. Two of the tribes assign a period of about twenty years as the limit of the ordinary small fluctuation of the lake. It seems probable from their statements that the total period may be divided roughly into five years of high water, five years of falling level, five years of low water, and five years of rise. Finally, at the end, apparently, of four or five twenty-year periods of fluctuation, there occurs an almost complete desiccation, which is followed by a great rise of level.

One old native remembered the last great drying up, which, on his evidence, is assigned to a period between 1828 and 1833; while nearly twenty years later, in 1851, the level was very high. The same native said that his grandfather told of an earlier desiccation which he had seen. During 1906 the lake was very low.

These notes seem to confirm the conclusions reached by Lieut. Boyd Alexander, who does not endorse the theory of the past few years that Lake Chad is now undergoing an exceptional period of desiccation. His view is that the present low stage of water is an ordinary phenomenon, the lake being subject to periodical changes of level.

PROF. HENRY FAIRFIELD OSBORN in his article, *Hunting the Ancestral Elephant in the Fayûm Desert* (*The Century Magazine*, October, 1907), presents a Map of the Region Explored by the Expedition of the American Museum. Of this map Mr. Cope Whitehouse speaks as follows (in a communication to the *New York Times Saturday Review of Books*, of October 5, p. 606):

The map printed in the *Century Magazine* is copied from that of a Mr. Beadnell. Its abundant errors are easily detected by a comparison with the maps drawn by me, or the one revised by the British War Office under my personal supervision.

It is to be regretted that Prof. Osborn had not found time to study the *BULLETIN* of the Society, which Mr. Whitehouse presented to him before his departure on his expedition.

EAST AFRICA BETWEEN VICTORIA NYANZA AND KILIMANJARO.—The summary given in the *Geographical Journal* (July, 1907) of the characteristics of the region through which the Anglo-German Boundary Commission passed, gives notable information about the country along the boundary. It differs in no way from the usual African upland bush, whose characteristics vary but little in the altitudes from 1,500 to 5,000 feet above the sea. At altitudes greater than 6,000 feet, the vegetation assumes a more park-like character, such as one is accustomed to see in England. The density of forest growth depends upon rainfall or condensation, which varies according to the aspect of the slopes. These conditions include all the varieties of country in the region surveyed.

Looking at the map, we see that the country from Lake Jipé on the east gradually rises to the plains east and north of Kilimanjaro, culminating at a height of 19,318 feet in the highest point of the snow-covered crater edge of Kibo. From these plains the country gradually rises to Mount Erok, falling again through a very broken country full of countless successions of parallel (north and south) faults to the bottom of the great Rift Valley.

This is the lowest level reached by the survey, 2,000 feet at Lake Natron. The western escarpment of the Rift Valley rises from the shore of this lake to a height of over 7,000 feet in a single and almost vertical steep to the summit of Mount Sambu. The boundary line then rises to about 8,300 feet over a series of rugged spurs and deeply-cut, densely-wooded gorges. The park-like country at the summit gives way gradually, as the country falls, to the drier thorn bush of the Mara River plains. Then from the top of the Isuria escarpment, which, unlike the western side of the Rift Valley, rises as an almost unbroken barrier along its whole length, are the scattered clumps of bushes and long grass, giving way, as the country falls to the shore of Victoria Nyanza, to the thorn bush and yellow burned-up grass of the lower veld.

NO COAL IN NORTH AFRICA.—Up to the present time no deposit of coal has been discovered in the Sahara nor anywhere in North Africa. An attempt to ascertain whether coal really exists to the south of Algeria, has been made by Mr. E. F. Gautier, and the results of his explorations have been communicated to the Société d'Encouragement (*Bulletin*, Vol. cix, No. 3) by Mr. A. Carnot. No trace of coal was found, but an extensive Carboniferous area was traversed between Figuig and In Salah, and it is possible that coal exists concealed beneath the vast Cretaceous plateaux.

MR. SAVAGE LANDOR ON THE CONGO.—This traveller, whose recent book on Tibet has been most favourably received, lectured before the Royal Institution of London on May 31 on his journey across Africa, during which he visited the Congo State. He asserted that excellent order reigns in the Belgian Congo. The natives are happy and well treated. The country, far from having been ravaged, has been considerably developed, thanks to the construction of roads, the establishment of large rubber plantations, and the extensive cultivation of rice, millet, Indian corn, etc. Most of the assertions regarding the treatment of the natives are grossly exaggerated, if not altogether unfounded. He especially praised the Italian officers in the service of the Congo Free State, who, he says, have accomplished a remarkable work in that country. He was able to bear witness that the natives everywhere, as a consequence of the kindness with which they have been treated, show much affection for these officers.

RAILROADS IN THE CONGO STATE.—Mr. D. C. Boulger, the well-known writer on Africa, has an excellent article on the railroads of the upper Congo in the *Engineering Magazine* (Vol. XXXIII, No. 4). It is a friendly estimate of Belgian enterprise and achievement in pushing the railroad across Africa from the west coast towards the great north and south artery of the Cape to Cairo line. Excellent photographs show the difficulty encountered in cutting the track through the dense forest.

WHEAT-GROWING IN EAST AFRICA.—The Department of Agriculture of British East Africa has published the results of experiments with several varieties of wheat, conducted at Nairobi on the high plateau of the interior both by the authorities and by settlers in the surrounding districts. Most of the experiments were unsuccessful owing to "rust," but a variety of wheat that appears to be well adapted to parts of the highlands has been obtained. The name of this variety is Glugas. It was introduced from South Australia. A large area in the highlands, particularly in the Njoro district, is apparently well suited for wheat-growing; and should further experiments this season prove successful, it is likely that another year will see the establishment of an extensive local wheat industry.

The Germans report, a little farther south in German East Africa, that important areas of the highlands are adapted for wheat-raising. In Mr. Fuchs' recent report to the German Colonial Industrial Committee, the photograph of a fine wheat field is shown. The high region of Ruanda, adjoining the Congo Free State, is said to be particularly adapted for wheat-growing. White settlers are not permitted to make homes in this region, as the natives are not yet entirely under control.

AMERICA.

CONCENTRATION OF GOLD IN THE KLONDIKE.—Mr. J. B. Tyrrell, the Canadian geologist, discusses in *Economic Geology* (June, 1907) the conditions in the Klondike gold-bearing district, where the origin and processes of deposition and concentration of the gold in its present position are quite easily recognized and interpreted. The more or less rectangular area of which his paper treats contains about 800 square miles. It is a well-defined physiographic unit, consisting of a mountain mass separated from surrounding mountains, except in the extreme southeast, by deep and wide valleys, from which the land rises in easy slopes to the highest point near the centre of the area. The country is largely underlain by schistose rocks, very old, probably Precambrian or Cambrian, and much folded and twisted. They have been greatly altered from the eruptives or sediments at first formed or deposited.

These schists are cut by many narrow veins, stringers, and lenses of gold-bearing quartz that seem to be present everywhere, although in no place sufficiently aggregated to pay for mining in themselves. They are, however, very important, as the gold collected in the placers of the valley bottoms was derived from them.

In some places around the margin of the district are outliers of Eocene sedimentary rocks. During that period the land seems to have been lowered so that the present 4,000 feet contour line was at or near the sea-level. About the close of the Eocene the land was lifted above the sea, and has not since been submerged, so that it has been subject for many ages to decom-

position and erosion. In the course of this work the rain and streams cut out the valleys, dissolved parts of the rock, and washed the undissolved particles from the higher to lower levels. The grains and nuggets of gold, being very heavy, settled close to the places from which they were derived.

The processes of decomposition and erosion went on from age to age until the land was reduced almost to its present level. The bottoms of the valleys were filled with coarse pebbles and cobbles, mixed with which were the smaller but heavier nuggets and grains of gold that had been washed out of the same hills but, on account of their weight, were not carried away with the rock particles of the same size. These beds of quartzite gravel are known as the "white gravel" or "white quartz wash."

After these gravel beds were formed, the north-flowing streams were accelerated and acquired greater cutting power, probably by a tilting of the land; and these streams, therefore, cut narrower valleys, with steeper sides, through the white gravel and into the underlying rock. Terraces of the white gravel were left on one or both sides of the valleys, and the streams reconcentrated into their beds the gold from the gravel which they had cut through and washed away, and also any gold that may have been in the rock cut through below the older gravel.

These two sets of gravel deposits have together produced about 6,000,000 fine ounces of gold; and it is not improbable that there are still 4,000,000 ounces remaining in the placers.

THE RAILROAD OVER THE ANDES.—The road over the Andes which Chile and Argentina are building, and which is the last link in the line across South America between the Atlantic and Pacific, is nearing its completion. It is said that the entire line will be open to trade next year. The Andes section of the road begins at Mendoza in Argentina, crosses the Andes through a tunnel 4 kilometers long, and extends to the Chilean town, Los Andes, which has rail connection with the Pacific.

FARMING AND GRAZING POSSIBILITIES IN ARGENTINA.—According to the *Bulletin* of the Bureau of American Republics, when all the arable lands of Argentina shall be cultivated there will be 300,000,000 acres under the plough, leaving as many more to be utilized in the raising of sheep and cattle. It is estimated that 200,000,000 people will be able to live and thrive on the plains of that country.

RECONSTRUCTION OF VALPARAISO.—Late last year the Chilean Minister of the Interior promulgated a law providing for the reconstruction of the city of Valparaiso. New streets are accordingly being opened, and conduits for gas, water, and sewerage are being laid in accordance with modern sanitary methods.

CATALOGUE OF EARTHQUAKES ON THE PACIFIC COAST.—The Smithsonian Institution has just issued in its Miscellaneous Collections (No. 1721) a Catalogue of Earthquakes on the Pacific coast for the ten years 1897-1906. It was prepared by Prof. Alexander G. McAdie of the U. S. Weather Bureau, San Francisco, and is a continuation of the catalogue made by Professor Edward S. Holden and issued in 1898 in the Miscellaneous Collections, No. 1087. The list covers 64 pages. The larger part of the earth-movements were recorded only by seismographs. Descriptions at some length are given of the more important movements. The sources of information are the Records of the U. S. Weather Bureau,

Lick Observatory, Students' Observatory at the University of California, the Observatory at Mare Island, and a manuscript list of earthquakes, compiled by Professor Harry Fielding Reid of Johns Hopkins University.

THE PILCOMAYO RIVER.—This river has its source in the Bolivian mountain ranges, and traverses the virgin forests of the Gran Chaco in a general southeasterly direction. For very many years the idea of utilizing the river for navigation has engaged the attention of the Argentine, Bolivian, and Paraguayan Governments and of private explorers, but without satisfactory results. A syndicate of capitalists decided in June, 1905, to send an expedition to study the navigable conditions of the river from its discharge into the Paraguay River to the colony of Buena Ventura, near parallel 22. The command of the expedition was offered to Civil Engineer Gunnar Lange, and his report (referred to in the September BULLETIN) has been translated into English and issued from the press of the Argentine Meteorological Office. It is accompanied by a map in seven sheets on a scale of 1.5 statute mile to an inch.

The expedition occupied four months. It numbered twenty-nine men, including the chief, two assistants, and a land-and-forest expert. A number of Indian tribes inhabit the country. None of them appear formidable or especially unfriendly. Many of them worked for the explorers, but the Tobas who killed Crevaux in 1882 worked only when they were paid in cotton shirts. An Argentine colony has been established at Buena Ventura, about 560 miles up the river. It contains about thirty families of colonists besides servants, intruders and squatters, bringing the total population up to about 1,000. Here is a brief summary of the conclusions reached as to the Pilcomayo and its navigability:

The river is navigable for the greater part of the year as far as Junta Fontana, for boats of not more than 1 meter draft.

The general inclines are favourable. It would not be very costly to clear the river of the numerous stumps and roots, and the serious want of water in times of drought might be remedied by the adoption of the series of locks and movable dams. A difficulty is presented by the sudden and very close turns of the river. This could be surmounted by cutting through the most pronounced bends.

From Junta Dorada to where the river leaves Bolivia there is no continuous navigation, but only interrupted streams, which disperse the water through a long series of swamps. Navigable canals with fourteen locks would have to be constructed above Junta Dorada, a distance of 135 kilometers.

It would be necessary to canalize the upper Pilcomayo with twenty-six locks, a distance of 228 kilometers. These improvements would secure throughout the whole year the depth of water required for uninterrupted navigation. The total cost is estimated at \$5,000,000.

THE PARANÁ RIVER.—The Comissão Geographica e Geologica do Estado de S. Paulo, continuing its hydrographic studies in that State, has now issued a monograph describing the results of the survey of that part of the Paraná River forming the State's western boundary. The chief result is the map on a scale 1:50,000, or 0.7 statute mile to an inch, which is large enough for a detailed delineation. The map is in eight sheets, some of which contain cross sections of the river. Many fine photographs of the stream, shores, and waterfalls are also given.

ASIA.

EDUCATIONAL REFORM IN CHINA.—Mr. E. T. Williams, Chinese Secretary of the American Legation at Peking, has sent a report on this subject, which is printed in the Report, just issued, of the Commissioner of Education (Vol. 1, 1905). It traces the history of the school-reform movement in China, indicates the phases it has now assumed, and is, in fact, a valuable study in the development of human institutions. In September, 1901, the Government took steps to establish a general system of public schools on modern lines. A complete and detailed plan for a national system of public schools, beginning with the kindergarten and crowned by the Imperial University, was approved by the Emperor and Dowager Empress on Jan. 13, 1904, and local authorities were directed to carry it into operation. These authorities found themselves hampered by their ignorance of the modern curriculum, by the lack of properly-qualified teachers, and by the want of suitable text-books. The teachers are being secured in part from students in the mission schools, and by the employment of a few Europeans and Americans, but chiefly by the appointment of Japanese instructors.

The preparation of native teachers is being hastened by sending large numbers of students abroad for education. These students are supported by the Imperial Government or the various provincial authorities, and most of them have been sent to Japan, where thousands of them are in the schools. Text-books are being supplied in part by translations or original works prepared by missionaries or the various bureaux of translation which are now maintained by several of the provincial governments. These books, however, are to be subjected to revision, and new works are being prepared under Government supervision. The new school system has now been established in every province of China proper and bids fair to make rapid development in the near future. In Peking there are over forty schools of all grades and in the province of Chihli more than 3,000 schools. One serious defect is that no provision has been made for the education of girls, except in the kindergarten. By Imperial edict in December, 1905, the Board of Education was organized to have general control of the new school system.

WEST CHINA MISSION M. E. CHURCH, J. F. PEAT, *Presiding Elder*.—

CHUNGKING, WEST CHINA, Aug. 21, 1907.

Ed. Bulletin American Geog. Society.

DEAR SIR:—A late experience of mine may be of interest to those of your readers who may be travellers, or to those who appreciate a nice practical problem.

On the evening of Aug. 15, 1907, with an assistant to count seconds, I located my position by the following methods: I had as an outfit a good watch, but the time not accurately known, an eight-inch sextant, and an artificial horizon, current nautical almanac, and a book of tables. I first made observations on stars east and west (Altair and Arcturus) for my sidereal time, then I observed the moon's altitude from which I worked out her R. A. and thence the G. M. T. I then observed a south star (ϵ Sagittarius) near the meridian, and Polaris for my latitude. In all I took 37 observations in one hour and twelve minutes. I found that my latitude is $29^{\circ} 31' 45''$ N. and my longitude is 7 h. 10 m. 48 s. E. G. My latitude must be right to within ten seconds, and as Chungking is given, on the best authority to date, as 7 h. 6 m., and as we are about two miles east of the city

it seems unlikely that my longitude is more than three miles in error. Observations with the moon in other positions would tend to eliminate this error.

I call your attention to this method of locating a position because I know of no work that advocates it except Raper, who discounts it as a method to be used at sea, and says nothing of its use on land. It is a possible method for the traveller for two-thirds of the month, whereas good occultations are very rare; Lunar culminations require a theodolite and Lunar distances two sextants and observers.

My mean altitudes and mean times by watch of observations are as follows:

Valley View, Aug. 15, 1907.

Latitude about $29^{\circ} 32' N$.

Altair $\frac{1}{2}$ observed angle	$52^{\circ} 7' 55''$
Arcturus $\frac{1}{2}$ "	$38^{\circ} 39' 16''$
Moon's lower limb	$26^{\circ} 32' 18''$
Sag.	$26^{\circ} 1' 15''$
Polaris	$29^{\circ} 13' 24''$

Longitude about $7h. 10m.$

Time	$17h. 28m. 52.4s.$
"	$17h. 52m. 48.5s.$
"	$17h. 43m. 8.5s.$
"	$18h. 15m. 23s.$
"	$18h. 22m. 58s.$

I am, sincerely yours,
J. F. PEAT.

NEW MAPS.

AFRICA.

BRITISH EAST AFRICA—GERMAN EAST AFRICA.—Map of the Country North and South of the Anglo-German Boundary. Reduced from the Surveys of the British and German Commission during 1904-06. Scale, 1:500,000, or 7.89 statute miles to an inch. *Geog. Jour.*, July, 1907, London.

The map is a reduction from the topographic survey which was made on a scale of 1:100,000. The country on the British side of the boundary was surveyed by the British, that on the German side by the German section of the Commission. The map is based on a single series of triangles, and the heights are all trigonometrical.

CAPE OF GOOD HOPE.—Lieut. Elliot's expedition in N. W. Cape Colony. Scale, 40 statute miles to an inch. *Scot. Geog. Mag.*, August, 1907, Edinburgh.

Shows Elliot's route through the Karroo in the northwestern part of Cape Colony. The map makes some additions to the topographic delineation of this region.

CAPE OF GOOD HOPE.—Cape Colony, Reconnaissance Series. Sheets, 127-E (Orange River Mouth); 127-F (Stinkfontein); 127-K and L (Port Nolloth and O'Okiep), and 128-R (Britstown). Scale, 1:250,000, or 3.95 statute miles to an inch. Cape Colony Survey, Edward Stanford, Agent, London, 1907. (Price, 2s. per sheet.)

The work is based on the geodetic triangulation, and the surveys are being carried out by plane tabling. The method of the whole is similar to that employed by the U. S. Geological Survey in the west of the United States. The large amount of topographic and cultural information is very clearly expressed. The quality of the roads, the amount of water supply, the forest areas, wells, marsh, shrub, fords, etc., are shown.

GERMAN EAST AFRICA.—Das Untere Pangani Tal. Trigonometrisch und polygonometrisch aufgenommen, berechnet und gezeichnet, 1901-06 (mit Unterbrech-

ungen). Durch E. Kayser. Scale, 1:30,000, or 0.47 statute mile to an inch. *Mitt. aus den Deutschen Schutzgeb.*, Vol. XX, No. 3, Berlin, 1907.

A beautiful specimen of very detailed map work produced in colours showing the boundaries of the sisal hemp plantations, the areas covered by sugar cane, tracts tilled by the natives, the distribution of swamps, mangrove, forests, villages, etc.

GOLD COAST COLONY.—Sheet 72-K-IV. Scale, 1:100,000, or 1.57 statute mile to an inch. Major F. G. Guggisberg, Director of Surveys. Topographical Section, General Staff, London, 1907.

A survey of the Gold Coast Colony was rendered imperative on account of the large number of gold-mining concessions taken up by companies. The survey was begun in 1902, but the need of mapping the mining concessions was so great that the whole staff was practically employed on purely cadastral work until 1905, when Major Guggisberg was able to train a few natives for topographical work and to put two European parties into the service from time to time.

The survey is especially difficult because the country is covered by the densest forest. The traverses shown in red have been rigidly surveyed with theodolite and steel tape, every yard of the way being cut through the forest. The forest trees average about 180 feet in height, and the undergrowth runs up to about 60 feet. In spite of the great difficulties, the whole of the Gold Coast Colony and a part of Ashanti are now covered with a network of traverses from 4° 45' N. to 6° 45' N. and from 1° 12' E. to 2° 47' W. The present sheet gives the results of the cadastral surveys in the mining districts, shows boundaries, surveyed and unsurveyed roads, rivers, villages, and other cultural features.

ORANGE RIVER COLONY.—Sheets 125-U-IV (Odendaals Rust), and 125-U-II (Bothaville). Scale, 1:125,000, or 1.9 statute miles to an inch. Colonial Survey Section. Edward Stanford, Agent, London, 1907. (Price, 2s. per sheet.)

These are sheets of the Topographical Survey of the Orange River Colony. The work began late in 1905, and it is expected that the survey of the whole colony (area about 47,000 square miles) will be completed in five and a half years, and that all the sheets will be published by the middle of 1911. The survey is based upon the geodetic triangulation, which is being broken up into a secondary triangulation, of which the sides average about ten miles. The secondary points are plotted on plane tables, and the detailed survey depends upon rigorous plane-tableing. The present printing is the military edition, and the civil edition, showing farm boundaries, will follow later.

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JULY-SEPTEMBER, 1907.

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From Srinagar to the Sources of the Chogo Lungma Glacier. [12 Illustrations and Map.] (*From the Geographical Journal for March, 1905.*) pr., 8vo.

WRIGHT, HERBERT.—Rubber Cultivation in the British Empire. A Lecture delivered before the Society of Arts. Reprinted by permission. [4 Illustrations.] London, Maclaren & Sons. 1907. 16mo.

BOOK NOTICES.

Le Commerce Algérien. Par P. Delorme. (2 vols.) Vol. 1, vii and 472 pp.; Vol. 2, pp. 463 and lxiv. Many Statistical Tables. Government of Algeria, Algiers, 1906.

An exhaustive study of the commerce of Algeria from the point not only of its present condition, but also as to its development and future possibilities. The author examines closely into every field of productivity and the evidences affecting it. He treats, for example, not only of the production of and commerce in cereals in Algeria, but also in other countries, to show the relative position which Algeria occupies and the exterior influences which may affect her own productivity and trade. Every relation which Algeria sustains to France and foreign countries is carefully set forth. The work, therefore, contains not only a vast amount of information about the production and trade of Algeria but much relating to other lands. The section on olive oil, an important product of Algeria, for example, practically includes a study of the world's production and trade in this commodity. The statistical tables are very numerous and complete.

Marokkanische Sittenbilder. Von Grethe Auer. 308 pp. A. Francke, Bern, 1906. (Price, M. 3.50.)

The author of this book lived for some years on the Atlantic coast of Morocco. She had excellent opportunities to study the life of the people, both on the coast and in the western interior. Her books, of which this is the latest, are composed of sketches of the country, the customs of the people, their industries, the philosophy of their lives, travel experiences, scenery and other geographical aspects. This book, like its predecessors, is written with much literary skill. The author is a keen observer, and her work has been accepted in Europe as a valuable contribution to literature on Morocco. Among the chapters in this volume those describing travel in Morocco, the life of the female slave Yakut, and how the locusts came to Mazagan, are especially informing.

Jamaica. Painted by A. S. Forrest, described by John Henderson. x and 179 pp., 24 coloured illustrations. Adam and Charles Black, London, and The Macmillan Co., New York, 1906.

A series of sketches of Jamaica dealing with the negroes more largely than with the other inhabitants, which is perhaps not surprising, as the island has a coloured population of about 700,000 and less than 20,000 whites. The book treats nothing exhaustively, but gives such impressions as come to an observant traveller with sufficient leisure to see many things. Geography is subordinated to pen-pictures of native life and the aspects of the racecourse, the military camp, the courts of justice, such sport as alligator-shooting affords, black and white politics, and many other matters. The chapter on the railroad, however, supplies many glimpses of agricultural Jamaica, with its fields of pineapples, its pimento groves, and bananas. The commercial chapter gives the reasons for the once-ebbing fortunes of the island. The sugar planters still manage to eke out an existence, and are now introducing new methods of manufacture that are likely to save them from many of the failures that have afflicted them in the past generation.

The author says that, though the colony is British in name, it is really quite as much American as British; which is to be expected, as the United States take four-fifths of the exports and supply over one-half of the imports. The concluding chapters are of special interest to tourists, telling them of much that they should see and of many things they should not do. The numerous water-colours are a very attractive feature of the book.

Indiscreet Letters from Peking, being the Notes of an Eye-Witness, which set forth in some Detail, from Day to Day, the Real Story of the Siege and Sack of a Distressed Capital in 1900—the Year of Great Tribulation. Edited by B. L. Putnam Weale. New York, Dodd, Mead and Company, 1907. 447 p.

A German professor of law once made the psychology of the testimonies of eye-witnesses the subject of his investigations with a body of students. One of the exercises consisted in the following experiment. Suddenly, during the discussions, several students, on previous agreement with the instructor, but without the knowledge of the rest, arose and produced a sham-fight for just a few minutes, and the other students were then assigned the task of writing down their observations as in an affidavit, with the result that their depositions varied most widely and not one tallied with another. I never fail to think of this experiment whenever I try to compare and to reconcile the various reports given by eye-witnesses of the Boxer uprising and the siege of Peking. Much has been published about these events—much of very contradictory character—but it is nevertheless impossible to sift the truth in all points, or even in just those which are important, and to write the real history of that unprecedented movement and the reaction that followed it. Every new contribution, whether in the form of a diary or of memoirs, which may tend to clear up the situation during that epoch, or even some incidents only, must therefore be welcome as building material for the future historian. From this point of view the present publication secures its passport of legitimacy, despite its appearance so long *post festum*. The preface is dated "China, June, 1900," which is evidently an error, as at the close of it the siege of Port Arthur is alluded to, and the last chapters of the diary carry us down to October, 1900. The diary itself does not in all places convey the impression that it was actually and contemporaneously penned during the course of the events; many passages breathe too much foresight of what is to come, and in others the retouching becomes plain from an additional "as I shall show hereafter." When we are assured by the foreword that "much in these notes has had to be suppressed for many reasons, and much that remains may create some astonishment," it is to be regretted that no more vigorous and self-denying editing has been applied to a volume in which valuable accounts are intermingled with numerous worthless personal details and an obtrusive, most unpleasant animosity towards nearly every participant in the affairs. The unreserved exposure of the irritable nerves of the diary-writer, who gives vent to his pent-up anger at the inefficient diplomats in language not always diplomatic, leaves a bitter taste in the mouth of the reader, and thus many of his statements lose their convincing force. The reviewer speaks advisedly, as he had the pleasure of knowing personally most of the men, who are cited in the diary with their initials only. True it is—and in this point we concur with the diarist—that the extraordinary situation did not find the right man to face it, and that the only man who was probably equal to it met a premature and tragical fate; but we must not forget that such an extraordinary situation called for an extraordinary man, and that not all men are extraordinary, even if they are envoys

extraordinary. True it is, also, that the Ministers did not act the part of heroes during the siege; but this, as well as the previous and other points, could be told in a more dignified manner and with greater impartiality than in the harsh and passionate words of Putnam-Weale. He doubtless possesses a great amount of common sense and sound judgment. Some of the characteristics which he gives of personages—as, for example, Baron von Kettler—are surprisingly true and to the point; but the merciless and scornful exposition of only the petty, feeble sides of men in responsible offices, who, after all, are only human beings, does not mean the writing of history or the writing for history.

Much of the siege was earnest, much, also, was of the character of a comedy; and the crucial test of the historian to come will be the decision of what was real and what existed only in the overstrained and almost hysterical imagination of the beleaguered. According to all we now know, the attempt to magnify the siege as a gallant and heroic defence is out of place. The Chinese, if they but wanted, could have easily stormed the British Legation and massacred all its inmates. In this point Putnam Weale is right, beyond any doubt, in his assertion that it was the division of counsels among the Chinese which alone saved every one from a shameful death. This side of the affair still belongs to the mysteries hidden behind the curtain of the Chinese stage of action; and it would be worth while living to the time when the official history of the present dynasty shall be published, that one may be able to read the whole Chinese version of the course of events. The vivid description of the barbaric loots and outrages of the foreign troops, and the author's condemnation of these brutalities are perfectly justifiable, and if not always his mode of expression, at least his sincerity and straightforwardness must be acknowledged. On the whole, his diary offers very interesting contributions to psychology rather than to history, although, also, the future historian of "Peking 1900" will have to make use of it to some advantage; but we see no reason to envy him this arduous task.

B. L.

Die Völker Chinas. Vorträge, gehalten im Seminar für orientalische Sprache zu Berlin von Alfred Forke. Berlin, Karl Curtius, 1907. 90 p.

This paper, which has grown out of two public lectures delivered last winter at the Oriental Seminary of Berlin, contains, for popular instruction, the more noticeable facts of modern Chinese life, with side-lights on the Manchu, the peoples of Mongolia, Turkistan, and Tibet. It is unpretentious, offers no new material and no novel ideas, but is quite commendable as a first aid to those who are desirous of seeking succinct information on the subject. The character of these notes is entirely synthetic, no analysis or interpretation of phenomena being given, and the author's attitude towards many questions cannot always be approved of from the standpoint of a student of culture.

B. L.



**TRIANGULATION
OF THE
QUITO MERIDIAN ARC**

The map illustrates the Quito Meridian Arc, a series of triangulation stations along the equator in Ecuador. Key features include:

- Geographical Features:** Mira River, Santiago River, Guallabamba River, Blanco River, Guayaquil, Santo Domingo de los Colorados, Bahía de Caraquez, and the Cordillera de Saraguro.
- Triangulation Stations:** A network of stations connected by lines, including Guayaquil, Santo Domingo de los Colorados, Bahía de Caraquez, and various points along the rivers and coast.
- Coordinates:** The map is framed by latitude and longitude lines, with the equator (0°) and the 78°W meridian (180°) clearly marked.

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